Proceedings of the
American Association of Textile Chemists and Colorists

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MARCH 12, 1956

AATCC CALENDAR

COUNCIL

Apr 20 (Benjamin Franklin Hotel, Philadelphia, Pa); June 15; week of Sept 10th (New York, N Y); Nov 16; Jan 18, 1957.

NATIONAL CONVENTIONS

Sept 13-15, 1956 (Waldorf-Astoria, New York) (as part of the Perkin Centennial. Sept 10-15); 1957 (Boston); 1958 (Hotel Conrad Hilton, Chicago); 1959 (Washington, DC)

HUDSON-MOHAWK SECTION

March 16 (Hotel Johnstown, Johnstown, N Y); May 18 (Ladies Nite); June 22 (Annual Outing).

MID-WEST SECTION

May 5 (Plankington Hotel, Milwaukee, Wis); June 16 (Outing—Browns Lake Resort, Burlington, Wis)

NEW YORK SECTION

Mar 23, Apr 27, May 18 (Kohler's Swiss Chalet, Rochelle Park, N J).

NIAGARA FRONTIER SECTION

Apr 27 (U S).

NORTHERN NEW ENGLAND SECTION

Apr 27 (Lowell Technological Institute, Lowell, Mass); Sept 28 (Annual Outing—Wachusett Country Club, West Boylston, Mass); Oct 19 (Science Park, Boston, Mass); Dec 1 (Annual Meeting—Hotel Vendome, Boston)

PHILADELPHIA SECTION

Apr 20 (Ladies' Night — Benjamin Franklin Hotel, Philadelphia); May 25 (Annual Outing — Huntingdon Valley Country Club, Abingdon, Pa); Sept 28 (Abraham Lincoln Hotel, Reading, Pa); Nov 2 (John Bartram Hotel, Philadelphia, Pa); Dec 7 (Kugler's Restaurant, Philadelphia, Pa)

PIEDMONT SECTION

Apr 7 (Sir Walter Raleigh Hotel, Raleigh, N C); June 8-9 (Outing—Mayview Manor, Blowing Rock, N C); Oct 6 (Annual Meeting—Hotel Charlotte, Charlotte, N C)

RHODE ISLAND SECTION

Mar 22 (Crown Hotel and Providence Engineering Society); Apr 26 (Student Night, Rhode Island School of Design); May 25 (Ladies' Night, Sheraton-Biltmore Hotel); June 15 (Annual Outing, Pawtucket Country Club); Oct 18 (Johnson's Hummocks Grille); Dec 6 (Annual Meeting, Johnson's Hummocks Grille)

SOUTH CENTRAL SECTION

Apr 28 (Hotel Patten, Chattanooga, Tenn); June 22-23 (Lookout Mountain Hotel); Dec 1 (Hotel Patten)

SOUTHEASTERN SECTION

Apr 14 (Lindale, Ga); June 8-9 (Outing—Radium Springs, Albany, Ga); Sept 22 (Columbus, Ga); Dec 8 (Atlanta, Ga).

WESTERN NEW ENGLAND SECTION

Mar 16 (Rapp's Restaurant, Shelton, Conn); May 11 (Ladies' Night—Waverly Inn, Cheshire, Conn); June 15 (Outing); Oct 5 (Annual Meeting—Hartford, Conn); Nov 16 (Rapp's Restaurant, Shelton, Conn)

EMPLOYMENT REGISTER

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56-2

Education: BS, Chemistry & Dyeing, with honors.

Experience: Research chemist.

Age: 27; married; references; presently staff sergeant, radio, U S Air Force, to be discharged in May; laboratory work in dye application desired.

3-12, 3-26

MEMBERSHIP APPLICATIONS

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DRAFT ISO PROPOSAL ON METHODS FOR TESTING COLORFASTNESS OF TEXTILES

FOREWORD

The International Organization for Standardization was founded in 1947 and a Technical Committee 38 on Textiles was appointed. At the first meeting of this committee in 1948 a subcommittee on Color Fastness (ISO/TC 38/SC 1) was formed to coordinate the diverse methods of testing colorfastness used in the member countries with a view to developing a single, unified set of methods embodying the best features of those in use in the member countries. The methods which follow are the first fruits of the work.

These methods have been approved by the ISO subcommittee. They will be submitted to the main Technical Committee for adoption as Draft ISO Recommendations at a meeting to be held in Southport, England in May 1956. Following that, approval by a majority of all ISO Member Bodies and acceptance by the ISO Council will make them official "Recommendations" of ISO and may well lead to their establishment as national standards in each of the 33 member countries. International recognition will thus be attained.

The principal organizations responsible for the development of these methods in ISO have been the British Society of Dyers and Colourists, the Europäisch-Continentale Echtheits-Convention or Groupement d'Etudes Continental-Européen pour la Solidité des Teintures et Impressions (ECE), and the AATCC. Reports of progress in the work have appeared in *American Dyestuff Reporter* of Nov 12, 1951 and Dec 21, 1953.

The British and Continental organizations are already taking steps to replace their older tests with the ISO tests wherever possible. These 24 methods have the approval of AATCC. They are presented here for trial and adoption where feasible by all interested laboratories.

The work of the ISO Subcommittee on Color Fastness is by no means ended. Fifteen additional tests are under active consideration. They include tests for colorfastness to alkaline milling, acid planking, mild acid milling, cross dyeing of wool, decatizing, chlorinated water, degumming, steaming, sublimation, bleaching with sodium hypochlorite, mechanical washing at 60°C and 95°C, and washing in the presence of sodium hypochlorite, fastness to perspiration and to gas fumes. Proposed drafts of these tests will be discussed at a meeting of the subcommittee to be held in New York in September 1956.

CONTENTS

General

General principles of testing P150
Grey scale for assessing change in color P152
Grey scale for assessing staining P153

Color fastness to:—

Acid Spotting P154
Alkali spotting P154
Bleaching with hypochlorite P155
Bleaching with peroxide P155
Carbonizing with aluminum chloride P156
Carbonizing with sulfuric acid P156
Chlorination acid P157
Light: daylight P158
Mercerizing P160
Metals in the dyebath: chromium salts P160
Metals in the dyebath: iron and copper P161
Organic solvents P161
Potting P162
Pressing: hot pressing P162
Rubbing P163
Soda boiling P164
Stoving P164
Washing: hand washing P165
Water P166
Sea water P166
Water spotting P167

General Principles of Testing

1. Introduction

1.1 This standard provides general information about the methods for testing color fastness of textiles for the guidance of users. The uses and the limitations of the methods are pointed out, several terms are defined, an outline of the form of the methods is given, and the content of each section is discussed. Procedures common to a number of the methods are discussed briefly.

1.2 By *color fastness* is meant the resistance of the color of textiles to the different agencies to which textiles may be exposed during manufacture and subsequent use.

1.3 The methods may be used not only for assessing color fastness of textiles, but also for assessing color fastness of dyes. When so used, the dye is applied to the textile in specified depths of color by stated procedures and the textile is then tested in the usual way.

1.4 Each method is concerned with color fastness to a single agency. No directions are given for testing fastness to a succession of agencies, as the agencies of interest in a particular case and the order of application will vary.

1.5 The conditions in the tests have been chosen to correspond closely to treatments usually employed in manufacture and to conditions of ordinary use. At the same time, they have been kept as simple and reproducible as possible. As it cannot be hoped that the tests will duplicate all the conditions under which textiles are processed or used, the fastness ratings must be interpreted according to the particular needs of each user. They provide, however, a common basis for testing and reporting color fastness.

2. General principle

2.1 A specimen of the textile to be tested, with undyed cloth attached if staining is to be assessed, is subjected to the action of the agency in question. The extent of any change in color and that of any staining of the undyed cloth are assessed and expressed in fastness numbers.

3. Outline of form of the methods

3.1 The headings of the principal sections of the methods follow:

Purpose and scope
Principle
Apparatus and reagents
Specimen
Procedure
Report
Notes

4. Purpose and scope

4.1 Under this heading in each method are given the intended use of the method, its limitations, and definitions of any terms that may not be clear.

4.2 Details of the principal natural, artificial, and synthetic fibers which can be submitted to each test are given. These lists are by no means exclusive, and any dyed or printed cloth not mentioned in the method (whether manufactured wholly from one fiber or from a mixture of fibers) can be submitted to test. In such cases it is necessary to verify and note whether

the procedure is likely to cause any alteration in the fiber under test. This applies particularly to all the new synthetic fibers (polyacrylonitrile, pure or copolymer; polyvinyl, pure or copolymer; polyester; etc) currently being developed, of which any list is always likely to be incomplete.

5. Principle of individual methods

5.1 A concise statement of the principle of the method is given to enable the user to decide whether the method is what he is seeking.

6. Apparatus and reagents

6.1 The equipment and supplies required for the test are enumerated.

6.2 TEST SOLUTIONS———Distilled water is to be used for making test solutions. The concentrations of baths are given in milliliters per liter (ml/l) or grams per liter (g/l). The qualities of chemicals used are given in each method. For crystalline substances the amount of water of crystallization is given; and for liquids, the density.

7. Specimen

7.1 Directions are given for the preparation of the "specimen" or "composite specimen" to be tested and of the "test-control specimens" to be used.

7.2 By *specimen* is meant the small piece of material, usually taken from a larger sample or lot, that is to be submitted to the test.

7.3 By *composite specimen* is meant the specimen with attached undyed cloth used for assessing staining.

7.4 By *test-control specimen* is meant a specimen of known behavior used to ensure the carrying out of a test correctly.

7.5 PIECE GOODS———Specimens from woven and knitted fabrics, felts, and other piece goods should be free from creases, so that the treatment they receive may result in uniform action over the whole area.

7.6 YARNS———Yarns to be tested may be knitted into fabric, from which a specimen is taken. They may be wound parallel, eg, on a U-shaped wire frame, and then sewn between the undyed cloths. For dry treatments, close winding on a card is recommended. For certain wet treatments without accompanying undyed material, hanks of yarn may be used, tied at both ends.

7.7 FIBERS———Fibers may be tested by combing and compressing into a flat pad, which may then be sewn between the undyed cloths.

7.8 UNDYED CLOTH FOR STAINING———

7.8.1 The undyed cloth to be used for assessing staining, if not otherwise specified, should be of plain weave, of medium weight, and free from finishes, residual chemicals, and chemically damaged fibers. Cotton and linen should be bleached; other materials should be cleaned to their usual degree of whiteness without bleaching.

7.8.2 The fluidity value of the cotton cloth used for staining may not exceed 5 rhes when measured in the standard cuprammonium solution by the method of Clibbens and Geake (*J Textile Inst 19*, T 77 (1928)).

8. Conditioning

8.1 Special conditioning of specimens usually is not necessary, but specimens, and the undyed cloths used with them, should be neither moist nor very dry.

8.2 Tests in which differences in moisture content of the specimen and undyed cloths will influence the results should be in standard condition, ie, in moisture equilibrium with air having a temperature of $20 \pm 2°C$ ($68 \pm 4°F$) and relative humidity of $65 \pm 2\%$.

NOTE. In tropical and subtropical countries the standard condition is in moisture equilibrium with air having a temperature of $27 \pm 2°C$ ($81 \pm 4°F$) and relative humidity of $65 \pm 2\%$.

9. Procedure

9.1 The series of operations through which the specimen is taken are described including the assessment of color change and staining of undyed cloth. The use of test-control specimens is called for in some of the methods to ensure the carrying out of the tests correctly.

9.2 TOLERANCES———Tolerances are given for numerical values of dimensions, temperatures, and times that are considered critical. If no tolerance is given, the precision of the measurements need be only that to be expected when using common instruments and reasonable care. The precision is further indicated by the number of significant figures in the values given.

9.3 LIQUOR RATIO———By *liquor ratio* is meant the ratio of the volume of the liquor used in the treatment, expressed in milliliters, to the weight of the specimen or composite specimen (specimen plus undyed material), expressed in grams.

9.4 WETTING OUT———Special care must be taken when wetting specimens that they are uniformly saturated. In particular, when wool or materials containing wool are to be wetted out, it is necessary for them to be thoroughly kneaded by hand, with the flattened end of a glass rod, or with a mechanical device.

9.5 SPOTTING———For tests in which the material is spotted with water or a reagent and the drop worked in with a glass rod, care should be taken not to raise the surface of the material, otherwise there will be a change in the reflection of light and hence in appearance.

9.6 WETTING TO 100% INCREASE IN WEIGHT——— When the material is to be wetted to contain its own weight of liquor, it may be saturated with the liquor and then drawn between two rubber rollers, squeezed by means of a rubber roller on a glass plate, or centrifuged. Wringing by hand does not give uniform wetting.

9.7 TEMPERATURE———Temperatures are given in degrees centrigrade (°C) usually with a tolerance of plus or minus 2 degrees ($\pm 2°C$). For reliable results, continuous temperature control is essential.

10. Fastness of dyes

As the fastness of a dye depends on the depth of color, it is necessary to specify standard depths which are to be used by dye manufacturers. A main range of twenty standard depths covering the whole spectrum has been prepared, whose depth is referred to as 1; in addition two supplementary ranges have been prepared, one at twice the depth (referred to as 2) and the other at one-twenty-fifth of the depth (referred to as 1/25), which are to be used if additional fastness figures for pale and full colors are required. In all cases the fastness figures corresponding to the main standard depth 1 should be given.

These "standard depths" have been prepared on a matt fabric (wool gabardine) and on a bright fabric (viscose rayon).

These "standard depths" are not subjected to any fastness test but merely indicate at what depth of color the fastness figures of dye manufacturers have been obtained irrespective of dye or fiber.

11. Assessment of color fastness

11.1 Color fastness is assessed separately with respect to change in color of the specimen in the test and with respect to staining of undyed materials. Specimens and undyed cloths

should have cooled after drying and should have regained their normal moisture content before the assessment.

11.2 COLOR FASTNESS WITH RESPECT TO CHANGE IN COLOR———The change which occurs in a test may be a change in depth of color, a change in hue, a change in brightness, or any combination of these. Regardless of the character of the change, the assessment is based upon the magnitude of the visual contrast between two colored areas, one being the original material, and the other the tested specimen. This contrast is compared visually with the contrast represented by the five pairs of neutral color chips (or swatches of cloth) in the standard grey scale specified for the purpose under *Color fastness: Grey scale for assessing change in color.* Each step of the scale bears a fastness number between 5 (no contrast) and 1 (a large contrast). The fastness rating of the specimen is that number of the grey scale which corresponds to the contrast between the original and the treated specimens. If the latter lies between two of the controls of the scale, the specimen is given an intermediate rating, eg, 3-4 or 4-3 (these ratings being identical). A rating of 5 is given only when there is no difference between the tested specimen and the original material.

In assessing the results of tests for color fastness to light the exposed specimens are compared with the scale of eight standard dyed blue wool cloths, which have been exposed simultaneously. A grey scale is used only indirectly as a means of determining the degree to which fading should be carried out in the test (See *Color fastness to light: daylight).*

11.3 COLOR FASTNESS WITH RESPECT TO STAINING———The degree of staining of the undyed cloth either by absorption of dye from the bath or by direct transfer of color from the specimen is assessed by visual inspection of the side of the undyed cloth which was in contact with the specimen. Where the use of adjacent white (undyed) cloths is required by the method of test, the specimen is placed between them: when printed cloths are being investigated, the composite specimen is so arranged that the printed surface is in direct contact with half of each of the two undyed cloths. The color of the bath is ignored. The standard grey scale for assessing staining is used. It is specified under *Color fastness: Grey scale for assessing staining.* The steps of this scale run from 5 (no contrast), represented by a pair of white chips (or swatches of cloth), to 1 (a large contrast), represented by a white and a grey chip. The contrast between the original undyed cloth and that stained as a result of the test is rated with the aid of the scale in a similar way to that described for change in color in Paragraph 11.2. Staining is assessed without reference to the depth of color of the material tested. The staining is assessed for each type of undyed material in the test.

11.4 INFLUENCE OF PRETREATMENTS AND AFTERTREATMENTS———It is well known that certain pretreatments and aftertreatments affect the fastness properties of colored textiles. Thus any change in a colored material that takes place as a result of applying a fastness test may not necessarily be due to lack of fastness in the dye itself.

11.5 COLOR FASTNESS RELATIVE TO AN ACCEPTED STANDARD———The existence of a simple method of checking the color fastness of a dyed cloth by reference to a standard dyeing is extremely useful for authorities receiving goods in large quantities who wish to determine whether these are comparable with an accepted piece. Where it is not essential to determine the exact color fastness rating it may be sufficient to compare the cloth being investigated with a standard dyeing: this method is used when it is necessary to establish only whether the color fastness of the specimen to a particular agency is greater than, equal to, or less than that of the reference dyeing.

12. Conditions of viewing and illumination in assessing color fastness

12.1 In assessing color fastness, a piece of the original material and the tested specimen, or the undyed and stained cloths, are arranged side by side in the same plane and oriented in the same direction. Two or more layers are used if necessary to avoid effects of other backing on the appearance. The appropriate grey scale is placed nearby in the same plane. The surrounding field is uniform grey of a brightness slightly less than that of the darkest member of the grey scale for assessing change in color. The surfaces to be compared are illuminated by north sky light in the Northern Hemisphere, or equivalent source with illumination of 50 foot-candles or more. The light is incident upon the surfaces at approx 45°, and the direction of viewing is approx along the perpendicular to the plane of the surfaces.

13. Report

13.1 The information to be supplied in the report of the tests is indicated under this heading in the methods.

14. Notes

14.1 Sources of supply of materials called for in the tests, references to the literature, and other information not considered necessary for inclusion in the body of the test method are given under "Notes."

Color Fastness: Grey scale for assessing change in color

1. Purpose and scope

1.1 This standard describes the grey scale for assessing changes in color of textiles in color fastness tests and its use. A precise colorimetric specification of the scale is given as a permanent record against which newly prepared working standards and standards that may have changed can be compared (see Paragraph 4.1).

2. Principle

2.1 THE SCALE consists of five pairs of grey color chips (or swatches of grey cloth) each representing a visual difference in color and contrast. The differences represented, which are determined by the Adams chromatic value formula, and corresponding numerical fastness ratings are approximately as follows:

Color differences in NBS units	*Fastness rating*
0	5
1½	4
3	3
6	2
12	1

(See Paragraph 3.3)

2.2 FASTNESS RATING 5 is represented on the scale by two identical chips (or swatches) mounted side by side, neutral grey in color and having a reflectance of 12 ± 1% (see Paragraph 3). The color difference is 0.

2.3 FASTNESS RATINGS 4 TO 1, INCLUSIVE, are represented by a "reference" chip (or swatch) identical with those used for Grade 5, paired with similar but lighter neutral grey chips (or swatches), the visual differences in the pairs being in geometric steps of color difference, or contrast, as shown in the table.

2.4 USE OF THE SCALE———Place a part of the original textile and the tested specimen of it side by side in the sample plane and oriented in the same direction. Place the grey scale nearby in the same plane. The surrounding field should be uniform grey of a brightness slightly less than that of the darkest member of the grey scale. If necessary to avoid effects of the backing on the appearance of the textiles, use two or more layers of the original textile under both original and

tested specimens. Illuminate the surfaces with north sky light in the Northern Hemisphere, south sky light in the Southern Hemisphere, or equivalent source with illumination of 50 foot-candles or more. The light should be incident upon the surfaces at approx 45° and the direction of viewing approximately perpendicular to the plane of the surfaces. Compare the visual difference between original and tested textile with the differences represented by the grey scale. The fastness rating of the specimen is that number of the grey scale which corresponds to the contrast between the original and the treated specimens. If the latter lies between two of the contrasts of the scale, the specimen is given an intermediate assessment, eg, 3-4 or 4-3 (these ratings being identical). A rating of 5 is given only when there is no difference between the tested specimen and the original material.

2.5 DESCRIBING COLOR CHANGES IN FASTNESS TESTS———

2.5.1 In using the grey scale as outlined in Paragraph 2.4, the character of the change in color, whether in hue, depth, brightness, or any combination of these, is not rated: the overall difference, or contrast, between original and tested specimens, is the basis for the assessment.

2.5.2 If, as in rating dyes on textiles, for example, it is desired to record the character of the change in color of the textile in the test, appropriate qualitative terms may be added to the numerical rating, as illustrated by the following examples:

Rating	*Meaning*	
3	Contrast equal to Grade 3 of the grey scale	Change is a loss of depth of color only
3 redder	Contrast equal to Grade 3 of the grey scale	No significant loss in depth, but color has become redder
3 weaker, yellower	Contrast equal to Grade 3 of the grey scale	Loss in depth and change in hue have occurred
3 weaker, bluer, duller	Contrast equal to Grade 3 of the grey scale	Loss in depth and change in both hue and brightness have occurred
4-5 redder	Contrast intermediate between 4 and 5 of the grey scale	No significant loss in depth, but color has become slightly redder

2.5.3 When changes in color occur in two or three directions, it is considered neither feasible nor necessary to indicate the relative magnitude of each change, either in words (such as "much" or "little") or by number (eg, 1 = small, 3 = large), or even by putting the larger change first (ie, "bluer, duller" different from "duller, bluer").

2.5.4 When the space available for recording qualitative terms is restricted, as on pattern cards, the following abbreviations may be used:

Bl = bluer R = redder W = weaker D = duller
G = greener Y = yellower S = stronger Br = brighter

3. Colorimetric specification of the grey scale

3.1 The precise colorimetric specification of the standard grey colors of the scale given in this section is derived from paragraph 2.

3.2 Actual grey scales used as working standards should approximate to these colors closely, particularly in color spacing.

3.3 The color differences shall be measured by employing the Adams "chromatic value" formula

Color difference (NBS units) =

$$40\left([0.23\,\Delta V_y]^2 + [\Delta(V_x - V_y)]^2 + [0.4\,\Delta(V_z - V_y)]^2\right)^{0.5}$$

Actual grey scales used as working standards shall not deviate from the values specified in Paragraph 2.1 by more than the following amounts:

Grade	*Theoretical (NBS units)*	*Tolerance (NBS units)*
5	0	0
4	1.5	±0.2
3	3.0	±0.2
2	6.0	±0.5
1	12.0	±1.0

4. Notes and references

4.1 Grey scales may be obtained from:

The Society of Dyers and Colourists, 19, Piccadilly, Bradford 1, Yorkshire, England.

Beuth Vertriebs GmbH Berlin W15, and Cologne, Germany.

American Association of Textile Chemists and Colorists, Lowell Technological Institute, Lowell, Mass, USA.

Color fastness: Grey scale for assessing staining

1. Purpose and scope

1.1 This standard describes the grey scale for assessing staining of undyed textiles in color fastness tests and its use. A precise colorimetric specification of the scale is given as a permanent record against which newly prepared working standards and standards that may have changed can be prepared (see Paragraph 3).

2. Principle

2.1 THE SCALE consists of one pair of white and four pairs of grey and white color chips (or swatches of grey and white cloth) each representing a visual difference in color or contrast. The differences represented, which are determined by the Adams chromatic value formula, and corresponding numerical fastness ratings are as follows:

Color differences (NBS units)	*Fastness rating*
0	5
4	4
8	3
16	2
32	1

2.2 FASTNESS RATING 5 is represented on the scale by two identical white chips (or swatches) mounted side by side, having a reflectance of not less than 85%. The color difference is 0.

2.3 FASTNESS RATINGS 4 TO 1, INCLUSIVE, are represented by a reference white chip (or swatch) identical with those used for rating 5, paired with similar but neutral grey chips (or swatches), the visual differences in the pairs being in geometric steps of color difference, or contrast, as shown in the table.

2.4 USE OF THE SCALE———Place a piece of the unstained undyed textile and the treated piece of it side by side in the same plane and oriented in the same direction. Place the grey scale nearby in the same plane. The surrounding field should be uniform grey of a brightness slightly less than that of the darkest member of the grey scale for assessing change in color. If necessary to avoid effects of the backing on the appearance of the textiles, use two or more layers of the unstained undyed textile under both unstained and treated pieces. Illuminate the surfaces with north sky light in the Northern Hemisphere, south sky light in the Southern Hemisphere, or equivalent source of illumination of 50 foot-candles or more. The light should be incident upon the surfaces at approx 45°, and the direction of viewing approximately perpendicular to the plane of the surfaces. Compare the visual difference between original undyed and treated pieces with the differences represented by the grey scale. The fastness rating of the specimen is that number of the grey scale which corresponds to the contrast between original and treated pieces. If this lies between two of the contrasts of the scale, the specimen is given an intermediate assessment, eg, 3-4 or 4-3 (these ratings being identical). A rating of 5 is given

only if there is no difference between the treated piece and the original undyed material.

3. Colorimetric specification of the grey scale

3.1 The precise colorimetric specification of the standard grey colors of the scale given in this section is derived from Paragraph 2.

3.2 Actual grey scales used as working standards should approximate to these colors closely, particularly in color spacing.

3.3 The color differences shall be measured by employing the Adams chromatic value formula.

Color difference (NBS units) =

$$40\left(\{0.23\,\Delta\,V_1\}^2+\{\Delta(V_x-V_y)\}^2+\{0.4\,\Delta\,(V_z-V_y)\}^2\right)^{0.5}$$

Actual grey scales used as working standards shall not deviate from the values specified in Paragraph 2.1 by more than the following amounts.

Grade	*Theoretical (NBS units)*	*Tolerances (NBS units)*
5	0	0
4	4	±0.3
3	8	±0.5
2	16	±1.0
1	32	±2.0

4. Notes and references

4.1 Grey scales may be obtained from:

The Society of Dyers and Colourists, 19, Piccadilly, Bradford 1, Yorkshire, England.

Beuth Vertriebs GmbH Berlin W15, and Cologne, Germany.

American Association of Textile Chemists and Colorists, Lowell Technological Institute, Lowell, Mass, USA.

Color fastness to acid spotting

1. Purpose and scope

1.1 This method is intended for assessing the resistance of the color of textiles of all kinds and in all forms to the action of dilute solutions of organic and mineral acids.

1.2 Three tests differing in severity are provided. Any or all may be used depending upon the nature of the fiber.

2. Principle

2.1 Drops of the acid solution are worked into the textile with a glass rod, and the changes in color of the textile while it is still wet and after drying are assessed with a standard grey scale.

3. Apparatus and reagents

3.1 Pipette or dropper.

3.2 Glass rod with rounded end.

3.3 Grey scale for assessing change in color (see Paragraph 7.1).

3.4 Acetic acid solution containing 300 g glacial acetic acid per liter.

3.5 Sulfuric acid solution containing 50 g concentrated sulfuric acid (sp gr 1.84) per liter.

3.6 Tartaric acid solution containing 100 g tartaric acid per liter (especially for acetate rayon, instead of acetic acid).

4. Specimen

4.1 If the textile to be tested is fabric, a piece at least 10 cm x 4 cm is required.

4.2 If the textile to be tested is yarn, knit it into fabric and use a piece at least 10 cm x 4 cm, or make a wick of parallel length 10 cm long and about 0.5 cm in diameter tied near both ends.

4.3 If the textile to be tested is loose fiber, comb and compress enough of it to form a sheet at least 10 cm x 4 cm.

5. Procedure

5.1 Spot the specimen with two drops of the appropriate solution at room temperature. Work the drops into the specimen with the glass rod.

5.2 Dry the specimen in air at room temperature.

5.3 Assess the change in color with the grey scale (see Paragraph 7.1).

6. Report

6.1 Report the numerical rating for change in color for each kind of acid used (and for change in color when wet if of interest).

7. Note

7.1 See the following sections:

a *Color fastness of textiles: General principles of testing* (especially Paragraph 9.5).

b *Color fastness: Grey scale for assessing change in color.*

Color fastness to alkali spotting

1. Purpose and scope

1.1 This method is intended for assessing the resistance of the color of textiles of all kinds and in all forms to the action of dilute alkaline solutions.

2. Principle

2.1 Drops of a solution of sodium carbonate are worked into the textile with a glass rod, and the change in color is assessed with a standard grey scale.

3. Apparatus and reagents

3.1 Pipette or dropper.

3.2 Glass rod with rounded end.

3.3 Grey scale for assessing change in color (see Paragraph 7.1).

3.4 Sodium carbonate solution containing 100 g anhydrous sodium carbonate per liter.

4. Specimen

4.1 If the textile to be tested is fabric, a piece at least 10 cm x 4 cm is required.

4.2 If the textile to be tested is yarn, knit it into fabric and use a piece at least 10 cm x 4 cm or make a wick of parallel lengths 10 cm long and about 0.5 cm in diameter tied near both ends.

4.3 If the textile to be tested is loose fiber, comb and compress enough of it to form a sheet at least 10 cm x 4 cm.

5. Procedure

5.1 Spot the specimen with two drops of the sodium carbonate solution at room temperature. Work the drops into the specimen with the glass rod. Dry the specimen in air at room temperature; brush it to remove sodium carbonate residues.

5.2 Assess the change in color with the grey scale (see Paragraph 7.1).

6. Report

6.1 Report the numerical rating for change in color.

7. Note

7.1 See the following sections:

a *Color fastness of textiles: General principles of testing* (especially Paragraph 9.5).

b *Color fastness: Grey scale for assessing change in color.*

Color fastness to bleaching with hypochlorite

1. Purpose and scope

1.1 This method is intended for assessing the resistance of the color of textiles in all forms to the action of bleaching baths containing sodium and calcium hypochlorite in concentrations normally used in commercial bleaching. It is applicable principally to natural and regenerated cellulose materials.

2. Principle

2.1 A specimen of the textile is agitated in solution of sodium hypochlorite, rinsed in water, agitated in hydrogen peroxide solution, rinsed, and dried. The change in color is assessed with a standard grey scale.

3. Apparatus and reagents

3.1 Sodium hypochlorite solution containing 2 g of available chlorine per liter, buffered at pH 11.0 ± 0.2 with 10 g anhydrous sodium carbonate per liter, temperature 20 ± 2°C (68 ± 4°F). The weight of solution used to be 50 times that of the specimen. Sodium hypochlorite of the following composition shall be used:

Sodium hypochlorite	NaOCl	14-16%
Sodium chloride	NaCl	12-17%
Sodium hydroxide	NaOH	2.0% max
Sodium carbonate	Na_2CO_3	2.0% max
Iron	Fe	0.001% max

3.2 Hydrogen peroxide solution containing 2.5 ml of 30% hydrogen peroxide per liter. The weight of solution used to be 50 times the weight of the specimen.

3.3 Glass or glazed porcelain container which can be closed, for specimen and bleaching solution (see Paragraph 5.1).

3.4 Grey scale for assessing change in color.

4. Specimen

4.1 If the textile to be tested is fabric, use a specimen at least 10 cm x 4 cm (4 in x 1½ in).

4.2 If the textile to be tested is yarn, knit it into a fabric and use a specimen of it at least 10 cm x 4 cm, or make a wick of parallel lengths 10 cm long and about 0.5 cm in diameter tied near both ends.

4.3 If the textile to be tested is loose fiber, comb and compress some of it into a sheet at least 10 cm x 4 cm, and sew the sheet on a piece of unbleached desized cotton cloth to support the fibers.

5. Procedure

5.1 Wet out the specimen in distilled water, remove the excess water, and place the specimen in an open or loosely rolled form in the sodium hypochlorite solution (see Paragraph 3.1). Close the container and keep the specimen in the solution at 20 ± 2°C (68 ± 4°F) for 60 min. Avoid exposure to direct sunlight.

5.2 Rinse the specimen thoroughly in cold running water, and then stir it for 10 min in the hydrogen peroxide solution at room temperature.

5.3 Rinse the specimen thoroughly in cold, running tap water, remove the excess water, and dry the specimen in air at a maximum temperature of 60°C (140°F).

5.4 Assess the change in color of the specimen with the grey scale (see Paragraph 7.1).

6. Report

6.1 Report the numerical rating for change in color.

7. Notes

7.1 See the following sections:

a Color fastness of textiles: General principles of testing.

b Color fastness: Grey scale for assessing change in color.

Color fastness to bleaching with peroxide

1. Purpose and scope

1.1 This method is intended for assessing the resistance of the color of textiles of all kinds except polyamide, and in all forms to the action of bleach baths containing peroxide at concentrations commonly employed in textile processing.

2. Principle

2.1 A specimen of the textile in contact with specified undyed cloths is immersed in the bleaching solution, rinsed, and dried, and the change in color and the staining are assessed with standard grey scales.

3. Standards and equipment

3.1 Test tube, of diameter and length such that the test specimen roll will have a reasonably snug fit in the tube and be covered by the bleach solution.

3.2 Reflux condenser, fitting the test tube, may be used to reduce evaporation from the bleach bath during the test.

3.3 Bleach bath of the composition given in Table I.

TABLE I

COMPOSITION OF BLEACH BATH AND CONDITIONS OF USE

Starting bath (per liter of distilled water)	*Bath 1 (for natural and regenerated cellulose)*	*Bath 2 (for natural and regenerated cellulose)*	*Bath 3 (for wool and acetate rayon)*	*Bath 4 (for silk)*
Hydrogen peroxide (a), ml	5	—	20	20
Sodium peroxide (b), g	—	3	—	—
Sodium silicate (c), ml	5	5	—	5
Sodium pyrophosphate (d), g	—	—	5	—
Magnesium chloride (e), g	0.1	0.1	—	0.1
pH, initial value ± 0.2 (f)	10.5	11.5	9.3(g)	10.0
Temperature, °C ± 2°	90	80	50	70
Temperature, °F ± 4°	194	176	122	158
Duration of treatment, hrs	1	1	2	2
Liquor ratio	30:1	30:1	30:1	30:1

(a) 30% H_2O_2 by volume
(b) 100% Na_2O
(c) About 26% SiO_2 and 10% Na_2O (sp gr = 1.32, 35° Bé)
(d) $Na_4P_2O_7{,}10H_2O$
(e) $MgCl_2{,}6H_2O$
(f) Adjust by addition of NaOH soln if necessary
(g) The pH of the bath at the end of the test must not be less than 9.0

3.4 Two undyed cloths, each 10 cm x 4 cm, one piece made of the same kind of fiber as that in the textile to be tested, the second piece made of the fiber indicated in Table II, or as otherwise specified.

TABLE II

If first piece is:—	Second piece to be:—
Wool, silk, linen, or viscose rayon	Cotton
Cotton or acetate rayon	Viscose rayon

3.5 Grey scales for assessing the change in color and the staining of the undyed cloths (see Paragraph 7.1).

4. Specimen

4.1 If the textile to be tested is fabric, place a specimen of it 10 cm x 4 cm between the two pieces of undyed cloth (see Paragraph 3.4), and sew along all four sides to form a composite specimen.

4.2 If the textile to be tested is yarn, knit it into fabric and treat it as in Paragraph 4.1, or form a layer of parallel lengths of it between two undyed cloths, and sew around the four sides to hold the yarns in place.

4.3 If the textile to be tested is loose fiber, comb and com-

press some of it into a sheet 10 cm x 4 cm in size, place the sheet between the two undyed cloths, and sew around the four sides to form a composite specimen.

5. Procedure

5.1 Loosely roll the composite specimen in the direction of the long edge, place the 4 cm roll in the appropriate bleach solution (Table I) in the test tube, and keep it well covered for the time and at the temperature indicated in Table I.

5.2 Remove the specimen, rinse it for 10 min in cold, running tap water, and squeeze it. Remove the stitching on two long sides and one short side, open the specimen out, and dry at a temperature not exceeding 60°C (140°F) with the three parts in contact only at the one line of stitching.

5.3 Assess the change in color of the specimen and the staining of the undyed cloths with the appropriate standard grey scales (see Paragraph 7.1).

6. Report

6.1 Report the bleach solution used, the numerical rating for color change, and the numerical rating for staining of each kind of undyed fiber tested.

7. Note

7.1 See the following sections:

a Color fastness of textiles: General principles of testing.
b Color fastness: Grey scale for assessing change in color.
c Color fastness: Grey scale for assessing staining.

Color fastness to carbonizing with aluminum chloride

1. Purpose and scope

1.1 This method is intended for assessing the resistance of the color of textiles in all forms to the manufacturing operation designed to remove vegetable impurities by treatment with aluminum chloride at high temperature. It is mainly applicable to wool and textiles containing wool, particularly those containing also acetate rayon or polyamide fibers.

2. Principle

2.1 A specimen containing the aluminum chloride solution is dried, baked, rinsed, and neutralized, and the changes in color after rinsing, neutralizing, and drying are assessed with a standard grey scale.

3. Apparatus and reagents

3.1 Oven for drying specimens in air at 60 ± 2°C (140 ± 4°F) and baking in air at 115 ± 2°C (239 ± 4°F).

3.2 Aluminum chloride solution (sp gr 1.037) containing 51.4 g $AlCl_3$ per liter.

3.3 Ammonium hydroxide solution containing 2 ml of 20% NH_4OH per liter.

3.4 TEST-CONTROL SPECIMEN———A dyeing of Alizarin Red W (*CI* 1034) treated with potassium dichromate (see Paragraph 7.1).

3.5 Grey scale for assessing change in color (see Paragraph 7.2).

4. Specimen

4.1 If the textile to be tested is fabric, a piece at least 10 cm x 4 cm is required.

4.2 If the textile to be tested is yarn, knit it into fabric and use a piece at least 10 cm x 4 cm or make a wick of parallel lengths 10 cm long and about 0.5 cm in diameter tied near both ends.

4.3 If the textile to be tested is loose fiber, comb and compress enough of it to form a sheet at least 10 cm x 4 cm.

5. Procedure

5.1 Carry out the operation described in Paragraphs 5.2-5.4 inclusive with the specimen and with the test-control specimen in parallel in separate baths.

5.2 Immerse the specimen in the aluminum chloride solution for 15 min at room temperature (liquor ratio 20:1). Squeeze it to leave in 80% on its weight of solution.

5.3 Dry the specimen by hanging it in an oven for 30 min, or longer if necessary at 60 ± 2°C (140 ± 4°F). Then bake it by heating for 15 min at 115 ± 2°C (239 ± 2°F).

5.4 Rinse the specimen for 5 min in cold, running tapwater, and then divide it into two equal parts. Dry one half in air at a temperature not exceeding 60°C (140°F).

5.5 Agitate the other half for 30 min at room temperature in the ammonium hydroxide solution (liquor ratio 40:1). Then rinse it for 5 min in cold, running tapwater, and dry it in air at a temperature not exceeding 60°C.

5.6 Assess the effect on the unneutralized test-control specimen with the grey scale (see Paragraph 7.1). If the change in color is not equal to 4-5 yellower on the appropriate scale, the test has not been carried out correctly, and the operations described in Paragraphs 5.1-5.5 inclusive must be repeated with a fresh specimen and a fresh test-control specimen.

5.7 Assess the change in color of each half of the specimen with the grey scale (see Paragraph 7.2).

6. Report

6.1 Report the numerical rating for change in color for both the rinsed and the neutralized portions of the specimen.

7. Notes

7.1 TEST-CONTROL SPECIMEN———A well wetted-out pattern of wool cloth is entered at 40°C (140°F) into a dyebath containing 1% Alizarin Red W Powder, 10% sodium sulfate crystals ($Na_2SO_4 10H_2O$), and 3% acetic acid (30%), all percentages being calculated on the weight of the pattern, at a liquor ratio of 40:1.

The dyebath is raised to the boil in 30 min and boiled for a further 30 min. If necessary, the dyebath is exhausted by careful addition of 1-3% acetic acid (30%) or 1% sulfuric acid (sp gr 1.84) well diluted with water. The bath is boiled for a further 15 min after addition of the acid.

The dyebath is cooled down by addition of cold water, and 0.5% potassium dichromate dissolved in water is added. The dyebath is raised to the boil and boiled for 30 min.

The pattern is then removed, rinsed in cold running tapwater and dried.

7.2 See the following sections:

a Color fastness of textiles: General principles of testing.
b Color fastness: Grey scale for assessing change in color.

Color fastness to carbonizing with sulfuric acid

1. Purpose and scope

1.1 This method is intended for assessing the resistance of the color of textiles in all forms to the manufacturing operation designed to remove vegetable impurities by treatment with sulfuric acid at high tmperatures. It is mainly applicable to wool and textiles containing wool.

2. Principle

2.1 A specimen containing the sulfuric acid solution is dried, baked, rinsed, and neutralized, and the changes in color after rinsing, neutralizing, and drying are assessed with a standard grey scale.

3. Apparatus and reagents

3.1 Oven for drying specimens in air at 60 ± 2°C

(140 ± 4°F) and baking in air at 105 ± 2°C (221 ± 4°F).

3.2 Sulfuric acid solution containing 50 g concentrated sulfuric acid (sp gr 1.84) per liter.

3.3 Sodium carbonate solution containing 2 g anhydrous sodium carbonate per liter.

3.4 TEST CONTROL———A dyeing of Alizarin Red W (*CI* 1034) treated with potassium dichromate (see Paragraph 7.1).

3.5 Grey scale for assessing change in color (see Paragraph 7.2).

4. Specimen

4.1 If the textile to be tested is fabric, a piece at least 10 cm x 4 cm is required.

4.2 If the textile to be tested is yarn, knit it into fabric and use a piece at least 10 cm x 4 cm, or make a wick of parallel lengths 10 cm long and about 0.5 cm in diameter tied near both ends.

4.3 If the textile to be tested is loose fiber, comb and compress enough of it to form a sheet at least 10 cm x 4 cm.

5. Procedure

5.1 Carry out the operations described in Paragraphs 5.2-5.5 inclusive with the composite specimen and the composite test-control specimen in parallel, in separate baths.

5.2 Immerse the specimen in the sulfuric acid solution for 15 min at room temperature (liquor ratio 20:1). Squeeze it to leave in 80% on its weight of solution.

5.3 Dry the specimen by hanging it in an oven for 30 min or longer if necessary, at 60 ± 2°C (140 ± 4°F). Then bake it by heating for 15 min at 105 ± 2°C (221 ± 4°F).

5.4 Rinse the specimen for 5 min in cold, running tapwater and then divide it into two equal parts. Dry one half in air at a temperature not exceeding 60°C (140°F).

5.5 Agitate the other half for 30 min at room temperature in the sodium carbonate solution (liquor ratio 40:1). Then rinse it for 5 min in cold, running tapwater and dry it in air at a temperature not exceeding 60°C (140°F).

5.6 Assess the effect on the unneutralized test-control specimen with the grey scale. If the change in color is not equal to 2 yellower, the test has not been carried out correctly, and the operations described in Paragraphs 5.1-5.5 inclusive must be repeated with fresh composite specimens and a fresh composite test-control specimen.

5.7 Assess the change in color of each half of the specimen with the grey scale (see Paragraph 7.2).

6. Report

6.1 Report the numerical rating for change in color for both the rinsed and the neutralized portions of the specimen.

7. Notes

7.1 TEST CONTROL———A well wetted-out pattern of wool cloth is entered at 40°C (104°F) into a dyebath containing 1% Alizarin Red W powder, 10% sodium sulfate crystals ($Na_2SO_4.10H_2O$), and 3% acetic acid (30%), all percentages being calculated on the weight of the pattern, at a liquor ratio of 40:1.

The dyebath is raised to the boil in 30 min and boiled for a further 30 min. If necessary, the dyebath is exhausted by careful addition of 1-3% acetic acid (30%) or 1% sulfuric acid (sp gr 1.84) well diluted with water. The bath is boiled for a further 15 min after addition of the acid.

The dyebath is cooled down by addition of cold water, and 0.5% potassium dichromate dissolved in water is added. The dyebath is raised to the boil and boiled for 30 min.

The pattern is then removed, rinsed in cold running tap water and dried.

7.2 See the following sections—

a. Color fastness of textiles: General principles of testing

b. Color fastness: Grey scale for assessing change in color

Color fastness to chlorination, acid

1. Purpose and scope

1.1 This method is intended for assessing the resistance of the color of textiles of all kinds and in all forms to the manufacturing operation in which an acid hypochlorite solution is used to prevent wool textiles from shrinking.

2. Principle

2.1 A specimen of the textile in contact with undyed textiles of interest is treated successively with solutions of hydrochloric acid, sodium hypochlorite, and sodium sulfite, rinsed, and dried. The change in color of the specimen and the staining of the undyed textiles are assessed with standard grey scales. A test-control fabric is used.

3. Apparatus and reagents

3.1 Yarns of scoured unbleached undyed wool, undyed bleached cotton, and other fibers as desired for assessment of staining if fabrics or yarns are to be tested; comparable undyed fabrics if fibers are to be tested.

3.2 Hydrochloric acid solution containing 6 ml hydrochloric acid (sp gr 1.16) per liter.

3.3 Sodium hypochlorite solution containing 1 g of available chlorine per liter. Sodium hypochlorite of the following composition shall be used—

Sodium hypochlorite	NaOCl	14-16%
Sodium chloride	NaCl	17-17%
Sodium hydroxide	NaOH	2.0% max
Sodium carbonate	Na_2CO_3	2.0% max
Iron	Fe	0.001% max

3.4 Sodium sulfite solution containing 3 g $Na_2SO_3.7H_2O$ per liter.

3.5 TEST CONTROL———A dyeing of 1.5% Solway Blue GS on wool cloth (see Paragraph 7.1).

3.6 Standard grey scales (see Paragraph 7.2).

4. Specimen

4.1 If the textile to be tested is fabric, sew stitches of the undyed yarns (see Paragraph 3.1) at intervals of approx 1 cm into a specimen of the fabric at least 7.5 cm x 5 cm.

4.2 If the textile to be tested is yarn, knit it into fabric and make a composite specimen from it as in Paragraph 4.1.

4.3 If the textile to be tested is loose fiber, comb and compress some of it into a sheet at least 7.5 cm x 5 cm in size, place the sheet between the undyed wool and the undyed cotton or other fabrics, and sew the three together with stitching at intervals of 1 cm. The weight of the colored textile should approximate to that of the undyed wool.

4.4 TEST CONTROL———Prepare a composite specimen of the test-control dyeing (see Paragraph 3.5) in the way outlined for fabric in Paragraph 4.1.

5. Procedure

5.1 Carry out the operations described in Paragraphs 5.2-5.5 inclusive with the composite specimens and the composite test-control specimen in parallel in separate baths.

5.2 Immerse the composite specimen in the hydrochloric acid solution at a liquor ratio of 25:1 for 10 min at room temperature.

5.3 Add an equal volume of the sodium hypochlorite solution (see Paragraph 3.3) and keep the composite specimen immersed for a further 10 min.

5.4 Rinse the composite specimen thoroughly in cold, running tapwater, and then immerse it in the sodium sulfite solution (see Paragraph 3.4) for 10 min at 35-40°C (95-104°F) at a liquor ratio of 50:1.

5.5 Thoroughly rinse the composite specimen from Paragraph 5.4 in cold running water and dry it in air at a tem-

perature not exceeding 60°C (140°F).

5.6 Assess the effect on the test-control specimen with the grey scale. If the change in color is not equal to 3, the test has not been carried out correctly, and the operations described in Paragraphs 5.1-5.5 must be repeated with fresh composite specimens and a fresh composite test-control specimen.

5.7 Assess the change in color of the specimen and the staining of the undyed materials with the grey scales (see Paragraph 7.2).

6. Report

6.1 Report the numerical rating for change in color and the numerical rating for staining of each kind of undyed fiber tested.

7. Notes

7.1 TEST CONTROL———A well wetted-out pattern of wool cloth is entered at 40°C (104°F) into a dyebath containing 1.5% Solway Blue GS, 10% sodium sulfate crystals ($Na_2SO_4.10H_2O$), and 3% sulfuric acid, all percentages being calculated on the weight of the pattern, at a liquor ratio of 40:1.

The dyebath is raised to the boil in 15 min, and boiled for a further 45 min.

The pattern is then removed, rinsed in cold, running tapwater and dried.

7.2 See the following sections:

a. Color fastness of textiles: General principles of testing.
b. Color fastness: Grey scale for assessing change in color.
c. Color fastness: Grey scale for assessing staining.

Color fastness to light: daylight

1. Purpose and scope

1.1 This method is intended for assessing the resistance of the color of textiles of all kinds and in all forms to the action of daylight (see Paragraph 7.1).

1.2 The method may be used for rating dyes by applying the dye to textiles, under specified conditions and at a specified depth of color, and testing the dyed textiles.

2. Principle

2.1 A specimen of the textile is exposed to daylight under prescribed conditions, including protection from rain, along with eight dyed wool standards. The fastness is assessed by comparing the fading of the textile with that of the standards.

3. Standards and equipment

3.1 STANDARDS———

3.1.1 The standards for this test are blue wool cloths dyed with the dyes listed below. They range from No. 1 (very low light fastness) to No. 8 (very high light fastness) (see Paragraph 7.2).

Fastness rating:	*Dye*
1	Acilan Brilliant Blue FFR (Bayer)
2	Acilan Brilliant Blue FFB (Bayer)
3	Supranolcyanin 6B (Bayer) or Brilliantcyanine 6B (Ciba) or Coomassie Brilliant Blue R (ICI)
4	Supramin Blue EG (Bayer)
5	Solway Blue RN (ICI) or Acilan Fast Blue RX (Bayer) or Alizarine Light Blue R (Sandoz)
6	Alizarine Light Blue 4GL (Sandoz)
7	Soledon Blue 4BC Powder (ICI) or Indigosol O4B (Durand) or Anthrasol O4B (Hoechst)
8	Indigosol Blue AGG (Durand) or Anthrasol Blue AGG (Hoechst)

3.1.2 Master sets of the standard dyeings are to be filed in each country for reference.

3.2 EXPOSURE RACK, facing due south in the Northern Hemisphere, north in the Southern Hemisphere, and sloping at an angle of 45°, in a location such that shadows of surrounding objects will not fall on the exposed textiles, covered with window glass to protect the specimens from the weather, the glass being not less than 2.5 cm from the specimen and provided with adequate ventilation.

3.3 Opaque cardboard or other thin opaque material, eg, thin sheet aluminum, or cardboard covered with aluminum foil.

3.4 Grey scale for assessing change in color (see Paragraph 7.3).

4. Specimen

4.1 An area of the textile not less than 1 cm x 6 cm is used when the several periods of exposure are made side by side on the same piece, which is the preferred practice. The specimen may be a strip of cloth, yarns wound close together on a card or laid parallel and fastened on a card, or a mat of fibers combed and compressed to give a uniform surface and fastened on a card.

4.2 To facilitate handling, the specimen or specimens to be tested and similar strips of the standards may be mounted on a card in some such arrangement as indicated in Paragraph 7.5.

5. Procedure

5.1 Expose the specimen (or a group of specimens) and the standards simultaneously to daylight under the conditions enumerated in Paragraph 3.2 in such a manner and for such times as are necessary to evaluate fully the light fastness of each specimen relative to that of the standards, by successively covering the specimens and exposed standards throughout the time of the test. (See Paragraph 7.5 for two suggested methods of procedure).

5.2 PRELIMINARY ASSESSMENT OF LIGHT FASTNESS———When a change in color (see Paragraph 7.6) of the specimen under test can just be perceived, note the number of the standard showing a similar change, alternatively, when a change in color of Standard 3 can just be perceived, assess any change that has occurred in the specimen in comparison with the changes in Standards 1, 2, and 3 (see Paragraph 7.4). Continue to expose after the preliminary assessment as required to evaluate fully the light fastness.

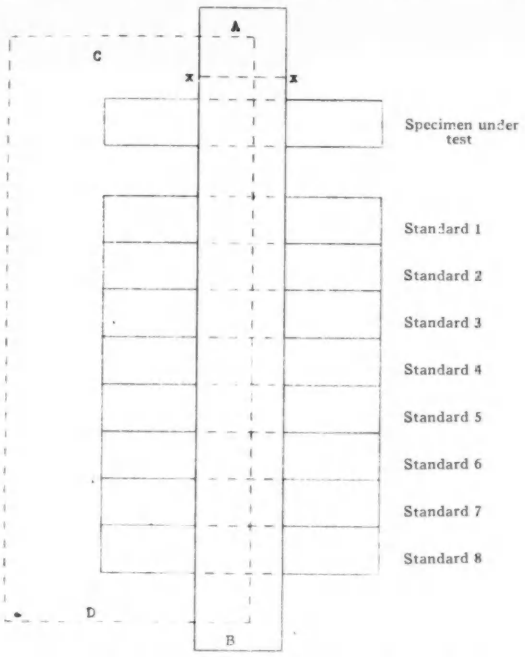
5.3 ASSESSMENT OF LIGHT FASTNESS———Compare the changes in color of the test specimen with the changes which have occurred in the standards (see Paragraph 7.6). The light fastness of the specimen is the number of the standard which shows similar changes in color (visual contrast between exposed and unexposed parts in the test). If the specimen shows changes in color intermediate between two standards, an appropriate half rating may be given; eg, a light fastness of 3-4 means that the textile is not as fast as Standard 4, but is faster than Standard 3.

5.4 If the color of the specimen is more fugitive than that of Standard No. 1, a rating of 1 is given.

5.5 If the light fastness is 4 or higher, the assessment based on the first perceptible change (see Paragraph 5.2) becomes significant; if this preliminary assessment is 3 or lower, it is to be included in the rating in brackets. For example, a rating of 6 (3) indicates that the specimen changes very slightly in the test when Standard 3 just begins to fade, but that on continuing the exposure the resistance to light is equal to that of Standard 6.

6. Report

6.1 Report the numerical rating for light fastness. If this rating is 4 or higher and the preliminary assessment is 3 or lower, report the latter figure in brackets.



AB Opaque cover. May be hinged at xx so that it can be lifted and returned to the same place over the specimen and standards.

CD Second cover.

Figure 1
Mounting for Method 1

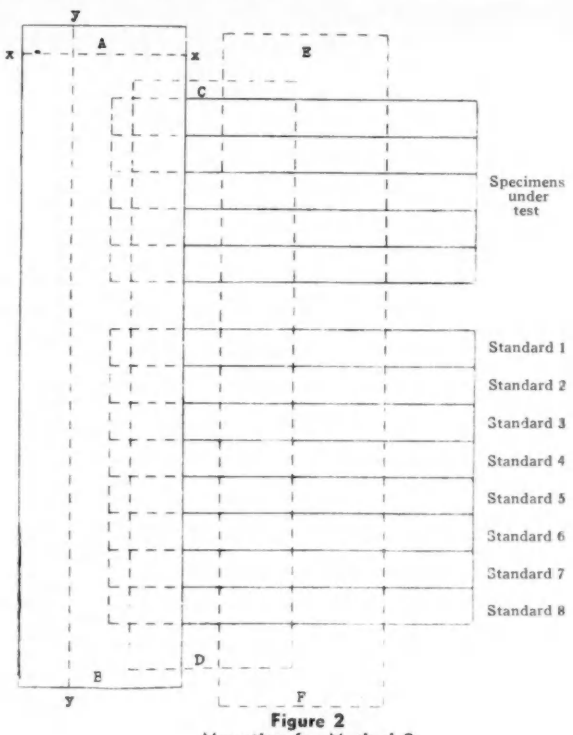


Figure 2
Mounting for Method 2

7. Notes

7.1 The use of fading lamps rather than daylight is common practice, and the results obtained with such tests are undoubtedly useful where speed is essential. The results obtained for many textiles differ, however, from the results obtained with daylight exposure.

A low-pressure mercury-vapor lamp must *not* be used, as its emission spectrum is very different from that of daylight and leads to incorrect results.

7.2 Sets of the light-fastness standards can be obtained from the British Standards Institution, British Standards House, 2, Park Street, London, W1, England, from Beuth Vertrieb GmbH, Berlin W15, and Cologne, Germany, and in other countries. They are specially dyed to match a master set of standards in color and in fading behavior. It has been found that, when repeated dyeings of the dyed standards are made, the amount of dye required to match the previous lot is often different from that originally used. The dyeing strengths would therefore be misleading, and they are intentionally omitted from this listing.

7.3 See the following sections:

a Color fastness of textiles: General principles of testing.

b Color fastness: Grey scale for assessing change in color.

7.4 Phototropic specimens must be allowed to condition in the dark at room temperature for 2 hr before assessing the change in color.

7.5 SUGGESTED PROCEDURES FOR MOUNTING AND TESTING FOR LIGHT FASTNESS———

7.5.1 METHOD 1:—

7.5.1.1 This method is considered ideal and should be used in cases of dispute. It requires one set of standards for each specimen under test and is therefore impracticable when a large number of specimens have to be tested concurrently; in such cases, Method 2 (see Paragraph 7.5.2) is suggested.

7.5.1.2 Arrange the specimen to be tested and the standards as shown in Fig 1 with an opaque cover across the middle third of the specimen and standards. Expose to daylight under the conditions enumerated in Paragraph 3.2. Follow the effect of light by removing the cover and inspecting the specimen frequently. When a change can just be perceived, note the number of the standard showing a similar change.

7.5.1.3 Continue to expose until the contrast between the exposed and the covered portion of the specimen is equal to the contrast between the two grey color chips illustrating Grade 4 on the grey scale (see Paragraph 7.3). Cover a second one-third of the specimen and standards with an additional opaque cover (CD in Fig 1).

7.5.1.4 Continue to expose until the contrast between the fully exposed and the unexposed portion is equal to Grade 3 on the grey scale. If Standard 7 fades to a contrast equal to Grade 4 on the grey scale before the specimen does, the exposure may be concluded at this stage. (When a specimen has a light fastness of 7 or over, it would require unduly long exposure to produce a contrast equal to Grade 3; moreover, this contrast would be impossible to obtain when the light fastness is 8. Assessments in the region 7 to 8 are, therefore, made when the contrast produced on Standard 7 is equal to Grade 4, the time required to produce this contrast being long enough to eliminate any error which might result from inadequate exposure.)

7.5.1.5 ASSESSMENT OF LIGHT FASTNESS——— The specimen now shows three separate areas — an unexposed region and two areas which have been changed to different degrees. Compare these changes with the

changes which have occurred in the standard, and rate the light fastness as in Paragraph 5.3.

7.5.2 METHOD 2:—

7.5.2.1 This method should be used when a large number of specimens have to be tested concurrently. It enables a number of specimens differing in light fastness to be rated against a single set of standards.

7.5.2.2 Arrange the specimens to be tested and the standards as shown in Fig 2, with card AB covering one-quarter of the total length of each specimen and standard. Expose to daylight under the conditions enumerated in Paragraph 3.2. Follow the effect of light by lifting the cover periodically and inspecting the *standards*. When a change in Standard 3 can just be perceived, inspect the specimens and rate their light fastness by comparing any change that has occurred with the changes that have occurred in Standards 1, 2, and 3.

7.5.2.3 Replace the card AB in exactly the same position, and continue to expose until a change in Standard 4 can just be perceived; at this point fix an additional cover CD in the position shown in Fig 2, overlapping the first cover.

7.5.2.4 Continue to expose until a change in Standard 6 can just be perceived; then fix the final cover EF in the position shown, the other two covers remaining in position. Expose until either a) a contrast is produced on Standard 7 equal to the contrast illustrated by Grade 4 of the grey scale, or b) a contrast equal to Grade 3 has been produced on the most resistant specimen, whichever occurs first. Remove the three covers.

7.5.2.5 Compare the changes in the specimens with those in the standards, and rate the light fastness as in Paragraph 5.3.

7.6 The term *change in color* includes not only true "fading," ie, destruction of dyes, but also changes in hue, depth, brightness, or any combination of these characteristics of color. If the difference in color is a change of hue or brightness, this can be indicated by adding abbreviations, as follows, to the numerical color-fastness rating:

Bl = bluer
G = greener
R = redder
Y = yellower
D = duller
Br = brighter

Color fastness to mercerizing

1. Purpose and scope

1.1 This method is intended for assessing the resistance of the color of textiles in all forms to the action of concentrated solutions of sodium hydroxide used in mercerizing. It is mainly applicable to cotton yarns and mixed-fiber yarns containing other natural cellulose fibers with cotton.

2. Principle

2.1 A specimen of the textile in contact with specified undyed cotton cloth is treated with the sodium hydroxide solution, rinsed, acidified, again rinsed, and dried. The change in color of the specimen and the staining of the undyed cloth are assessed with standard grey scales.

2.2 As completely resistant specimens show an apparent increase in depth of color, these would not be rated 5 by the normal method of assessment. In such cases, therefore, only the changes in hue or brightness shall be assessed using a standard grey scale, and such assessments shall be marked with an aterisk, eg, 5*, 3-4 *redder**, or 2 *bluer, duller**, and explained in a footnote.

2.3 Specimens which do not increase in depth shall be assessed in the normal manner and the results shall not be marked with an asterisk.

3. Apparatus and reagents

3.1 Undyed, bleached cotton cloth at least 10 cm x 10 cm for evaluating staining.

3.2 Frame for holding specimen (see Paragraph 4).

3.3 Sodium hydroxide solution, 300 g sodium hydroxide per liter.

3.4 Sulfuric acid solution, 5 ml concentrated sulfuric acid (sp gr 1.84) per liter.

3.5 Standard grey scales (see Paragraph 7.1).

4. Specimen

4.1 If the textile to be tested is fabric, sew a specimen of it at least 10 cm x 10 cm to an equal-sized piece of the undyed cloth (Paragraph 3.1) along all four sides. Fasten this composite specimen to a frame firmly, but without excessive tension, with the colored material uppermost.

4.2 If the textile to be tested is yarn or thread, wind it on a rigid frame firmly, but without excessive tension, with the strands close together and parallel to provide an area at least 10 cm x 10 cm. Sew an equal-sized piece of the undyed cloth to this area along the two sides across the strands, with the colored material uppermost.

5. Procedure

5.1 Immerse the composite specimen in the sodium hydroxide solution at $20 \pm 2°C$ ($68 \pm 4°F$) for 5 min.

Rinse it by pouring on 1 liter of water at $70 \pm 2°C$ ($158 \pm 4°F$) over a period of 1 min., and then rinsing in cold running tapwater for 5 min.

5.2 Remove it from the frame and immerse it in the sulfuric acid solution for 5 min at a liquor ratio of 50:1. Rinse it in cold, running tapwater until neutral.

5.3 Remove the stitching along three sides (one side for yarns and threads), and dry in air at a temperature not exceeding 60°C (140°F) taking care that the undyed cloth and the colored material are kept apart except at the stitching.

5.4 If the specimen shows increased depth of color, assess the change in hue or brightness only, using the appropriate grey scale. Assess the staining of the undyed cotton cloth with the appropriate grey scale (see Paragraph 7.1).

5.5 If the specimen does not show increased depth of color, assess the change as an overall contrast and the staining of the undyed cotton cloth with the grey scales (see Paragraph 7.1).

6. Report

6.1 In the case of assessments in accordance with Paragraph 5.4 report and mark with an asterisk any change in hue or brightness of the specimen, and report the numerical rating for staining of the undyed cotton cloth.

6.2 In the case of assessments in accordance with Paragraph 5.5, report the numerical rating for change in color and the numerical rating for staining of the undyed cotton cloth.

7. Note

7.1 See the following sections:

a Color fastness of textiles: General principles of testing.
b Color fastness: Grey scale for assessing change in color.
c Color fastness: Grey scale for assessing staining.

Color fastness to metals in the dyebath: chromium salts

1. Purpose and scope

1.1 This method is intended for assessing the effect, on the

color of a dye, of dyeing in the presence of hexavalent chromium salts. Alternative conditions are specified in Paragraph 5.3 to provide a milder test suitable for assessing the effect of chromium salts in such concentrations as might be found when shading.

2. Principle

2.1 The difference in color between dyeings made with and without potassium dichromate is assessed with the standard grey scale.

3. Apparatus and reagents

3.1 Two pieces of undyed light wool cloth of a size suitable for laboratory dyeing.

3.2 Two dyebaths and solutions usual for the dye.

3.3 Potassium dichromate solution containing 1% $K_2Cr_2O_7$.

3.4 Grey scale for assessing change in color (see Paragraph 7.1).

4. Specimen

4.1 See Paragraph 3.1.

5. Procedure

5.1 Make two dyeings of the dye at the standard depth of color on the wool cloth using the normal method for the dye under examination and a liquor ratio of 40:1.

5.2 METHOD 1———On completion of the dyeing add to one of the dyebaths sufficient potassium dichromate solution to give 1% $K_2Cr_2O_7$ on the weight of the wool. Maintain both baths at the boil for a further 60 min.

5.3 METHOD 2———On completion of the dyeing add to one of the dyebaths sufficient potassium dichromate solution to give 0.2% $K_2Cr_2O_7$ on the weight of the wool. Maintain both baths at the boil for a further 60 min.

5.4 Compare the color of the dyeing made in the presence of potassium dichromate with that of the dyeing made in its absence, and assess the difference with the grey scale.

6. Report

6.1 Report the dye used, the method and the strength of dyeing, and the numerical rating of the change in color.

7. Note

7.1 See the following sections:

a Color fastness of textiles: General principles of testing.

b Color fastness: Grey scale for assessing change in color.

Color fastness to metals in the dyebath: iron and copper

1. Purpose and scope

1.1 This method is intended for assessing the effect, on the color of a dye, of dyeing in the presence of metals either used in the construction of dyeing machinery or resulting from water and steam used in dyeing.

2. Principle

2.1 The difference in color between dyeings made in the presence and in the absence of salts of the metal is assessed with the standard grey scale.

3. Apparatus and reagents

3.1 Three pieces of undyed light wool cloth of a size suitable for laboratory dyeing.

3.2 Three dyebaths and solutions usual for the dye.

3.3 Copper sulfate solution containing 0.2% $CuSO_4,5H_2O$ on the weight of one piece of the wool (see Paragraph 3.1).

3.4 Ammonium ferric sulfate solution containing 0.5% $(NH_4)_2SO_4,Fe_2(SO_4)_3,24H_2O$ on the weight of one piece of the wool (see Paragraph 3.1).

3.5 Grey scale for assessing change in color (see Paragraph 7.1).

4. Specimen

4.1 See Paragraph 3.1.

5. Procedure

5.1 Make three dyeings at the standard depth of color on the wool cloth according to the usual method for the dye under examination. Before entering the fabric, add the ammonium ferric sulfate to one dyebath and the copper sulfate to another, and bring the liquor ratio in each bath to 40:1.

5.2 Compare the colors of the dyeings made in the presence of copper sulfate and of ferric sulfate with that of the dyeing made in their absence, and assess the differences with the grey scale.

6. Report

6.1 Report the dye used, the method and the strength of dyeing, and the numerical rating of the change in color.

7. Note

7.1 See the following sections:

a Color fastness of textiles: General principles of testing.

b Color fastness: Grey scale for assessing change in color.

Color fastness to organic solvents

1. Purpose and scope

1.1 This method is intended for assessing the resistance of the color of textiles of all kinds and in all forms to organic solvents, and in particular to solvents used in cleaning or mill processing.

2. Principle

2.1 A specimen of the textile in contact with specified undyed cloths is agitated in the solvent and dried. The change in color of the specimen and the staining of the undyed cloths are assessed with standard grey scales.

3. Apparatus and reagents

3.1 Suitable container with means of agitation (see Paragraph 7.1).

3.2 Specified solvent (see Paragraph 7.2).

3.3 Two undyed cloths, each 10 cm x 4 cm, one piece made of the same kind of fiber as that in the textile to be tested, the second piece made of the fiber indicated below, or as otherwise specified:

If first piece is—	Second piece to be—
cotton	wool
wool	cotton
silk	cotton
linen	wool
viscose rayon	wool
acetate rayon	viscose rayon
polyamide fiber	wool or viscose rayon
polyester fiber	wool

3.4 Grey scales for assessing change in color and staining of undyed cloths (see Paragraph 7.4).

4. Specimen

4.1 If the textile to be tested is fabric, place a specimen of it 10 cm x 4 cm between the two pieces of cloh required in Paragraph 3.3 and sew along all four sides to form a composite specimen.

4.2 If the textile to be tested is yarn, knit it into fabric and treat it as in Paragraph 4.1, or form a layer of parallel lengths of it between the two undyed cloths and sew around the four sides to hold the yarns in place.

4.3 If the textile to be tested is loose fiber, comb and compress enough of it to form a sheet 10 cm x 4 cm, place it between the two undyed cloths, and sew around the four sides to hold the fibers in place.

5. Procedure

5.1 Agitate the composite specimen continuously for 30 min in the solvent at room temperature with a liquor ratio of 40:1. If the agitation is by hand, the specimen must be pressed against the container every 2 min with a glass rod (see Paragraph 7.1) without removing the specimen from the solvent.

5.2 Squeeze excess solvent from the specimen and dry it in air at $80 \pm 2°C$ ($176 \pm 4°F$) without unstitching. Take the precautions necessary for safety in drying inflammable or explosive solvents.

5.3 Remove the stitching, and assess the change in color of the specimen and the staining of the undyed cloths with the grey scales (see Paragraph 3.4).

6. Report

6.1 Report the solvent used, the numerical rating for change in color, and the numerical rating for color staining of each kind of undyed fiber tested.

7. Notes

7.1 A 500-ml beaker or other suitable open container may be used for the test, agitation being by hand with a glass rod flattened at one end. A closed vessel agitated by shaking or tumbling in a hand- or motor-driven machine may be used.

7.2 The test should be carried out with the solvent or solvents commonly employed in the country concerned.

7.3 It is suggested that the kinds of fibers listed in Clause 3.3 be rated regularly. Others may be rated in addition.

7.4 See the following sections:

a Color fastness of textiles: General principles of testing.
b Color fastness: Grey scale for assessing change in color.
c Color fastness: Grey scale for assessing staining.

Color fastness to potting

1. Purpose and scope

1.1 This method is intended for assessing the resistance of the color textiles of all kinds and in all forms to the action of boiling water. It is mainly applicable to wool and textiles containing wool.

2. Principle

2.1 A specimen of the textile between undyed wool and cotton cloths is rolled around a glass rod and treated with boiling water. The cloths are separated and dried, and the change in color of the specimen and the staining of the undyed cloths are assessed with standard grey scales.

3. Apparatus and reagents

3.1 Vessel equipped with reflux condenser to hold a cylindrical specimen 4 cm long in boiling water.

3.2 Glass rod 5-8 mm in diameter.

3.3 Undyed unbleached wool cloth 10 cm x 4 cm.

3.4 Undyed bleached cotton cloth or the fiber used in admixture with the wool.

3.5 Grey scales for assessing change in color and staining of undyed cloths (see Paragraph 7.1).

4. Specimen

4.1 If the textile to be tested is fabric, place a specimen of it 10 cm x 4 cm between the two pieces of undyed cloth required in Paragraphs 3.3 and 3.4 and sew along one of the shorter sides.

4.2 If the textile to be tested is yarn, knit it into fabric and treat it as in Paragraph 4.1, or form a layer of parallel lengths of it between the two undyed cloths and sew around the four sides to hold the yarns in place.

4.3 If the textile to be tested is loose fiber, comb and compress enough of it to form a sheet 10 cm x 4 cm, place it between the two undyed cloths, and sew around the four sides to hold the fibers in place.

5. Procedure

5.1 Roll the composite specimen around the glass rod to form a cylinder 4 cm long and tie it loosely with thread.

5.2 Treat the specimen on the rod for 1 hour in boiling distilled water, at a liquor ratio of 30:1, under reflux.

5.3 Remove the specimen from the rod and separate the undyed cloths from it. Dry all three in air at a temparature not exceeding 60°C (140°F).

5.4 Assess the change in color of the specimen and the staining of the undyed cloths with the grey scales (see Paragraph 7.1).

6. Report

6.1 Report the numerical rating for change in color and the numerical rating for staining of each kind of undyed fiber tested.

7. Note

7.1 See the following sections:

a Color fastness of textiles: General principles of testing.
b Color fastness: Grey scale for assessing change in color.
c Color fastness: Grey scale for assessing staining.

Color fastness to pressing: hot pressing

1. Purpose and scope

1.1 This method is intended for assessing the resistance of the color of textiles of all kinds and in all forms to ironing and to processing on hot cylinders.

1.2 Tests are given for hot pressing when the textile is wet, when it is damp, and when it is dry.

2. Principle

2.1 For dry pressing, the dry specimen on a dry undyed cotton cloth is pressed with an iron of specified weight and temperature. For wet pressing, the wet specimen placed on a dry undyed cotton cloth and covered with a wet undyed cotton cloth is pressed with the iron. For damp pressing, the dry specimen is placed on a dry undyed cotton cloth, covered with a wet undyed cotton cloth, and pressed with the iron. The change in color and the staining of the undyed cloths are assessed with standard grey scales immediately and again after a period of exposure to air.

3. Apparatus and reagents

3.1 Hand iron of the proper weight to give a pressure of approx 30 g/sq cm (0.43 lb/sq in) (see Paragraph 7.1) at the temperature indicated in the following table (see Paragraph 7.2):

Fabric	*Temperature*	
	(°C)	*(°F)*
Cotton and linen	190-210	374-410
Wool, silk and viscose rayon	140-160	284-320
Acetate rayon and polyamide fibers	115-120	239-248

3.2 Undyed bleached cotton cloth weighing approx 125 g/sq meter (3.7 oz/sq yd). Five pieces not less than 14 cm x 4 cm are required.

3.3 Grey scales for assessing change in color and staining (see Paragraph 7.3).

4. Specimen

4.1 If the textile to be tested is fabric, a piece 10 cm x 4 cm is required.

4.2 If the textile to be tested is yarn or thread, knit it into fabric and use a piece 10 cm x 4 cm, or wind it around a piece of thin cardboard 14 cm x 4 cm to obtain the area of the textile for test.

5. Procedure

5.1 Specimens of materials that have been subjected to any heat or drying treatment must be allowed to condition (by exposure to air at 65% relative humidity and 20 ± 2°C) before they are tested.

5.2 DRY PRESSING———Place the specimen on the piece of dry cotton cloth (see Paragraph 3.2) on a smooth horizontal surface. Place the iron on top and leave it for 15 seconds.

5.3 WET PRESSING———Soak the specimens and a piece of the cotton cloth (Paragraph 3.2) in distilled water, and squeeze or extract them to contain their own weights of water. Place the wet specimen on a piece of the dry cotton cloth (see Paragraph 3.2) and place the wet cotton cloth on the specimen. Press by moving the iron to and fro over the wet cloth (without additional pressure) for 15 seconds.

5.4 DAMP PRESSING———Place the dry specimen on a piece of the dry cotton cloth (see Paragraph 3.2). Soak another piece of the undyed cloth in distilled water, and squeeze or extract it to contain its own weight of water. Place the wet cloth on the specimen. Press by moving the iron to and fro over the wet cloth (without additional pressure) for 15 seconds.

5.5 Assess the change in color of the specimen with the appropriate grey scale (see Paragrah 7.3) immediately and again after the specimen has been allowed to condition for 4 hours in the standard atmosphere, viz 65% relative humidity and 20 ± 2°C (68 ± 4°F).

5.6 Assess the staining of the undyed cloths with the appropriate grey scale (see Paragraph 7.3). In wet pressing (see Paragraph 5.3) and in damp pressing (see Paragraph 5.4) the staining shall be assessed on the undyed cloth which shows the greater amount of staining.

6. Report

6.1 Report the numerical rating for the change in color for dry, wet, and damp pressing immediately after testing and after conditioning for 4 hours. Report the numerical rating of the staining of the undyed cloth.

7. Notes

7.1 The pressure on the cloth under test will depend upon the area of the bottom of the iron lying over the 14 cm x 4 cm specimen.

7.2 The measurement of the surface temperature of the iron shall be made by means of an electric surface pyrometer or by observing the behavior of crystals such as *m*-hydroxybenzoic acid (mp 200°C, 392°F) citric acid (mp 153°C, 307°F) or benzoic acid (mp 122°C, 252°F) when placed on the iron.

7.3 See the following sections:

a Color fastness of textiles: General principles of testing.
b Color fastness: Grey scale for assessing change in color.
c Color fastness: Grey scale for assessing staining.

Color fastness to rubbing

1. Purpose and scope

1.1 This method is intended for assessing the resistance of the color of textiles of all kinds and in all forms to rubbing off and staining other materials.

1.2 Two tests are made, one with a dry rubbing cloth and one with a wet rubbing cloth.

2. Principle

2.1 Specimens of the textile are rubbed with dry undyed cotton cloth and with wet undyed cotton cloth. The staining of the undyed cloths is assessed with the standard grey scale.

3. Apparatus and reagents

3.1 Crockmeter or its equivalent (see Paragraph 7.1)

3.2 Undyed bleached cotton lawn or similar cloth free from starch or other finish, cut into 5 cm (2 in) squares (see Paragraph 7.2).

3.3 Grey scale for assessing staining of undyed cloth (see Paragraph 7.3).

4. Specimen

4.1 If the textile to be tested is fabric, two pieces not less than 14 cm x 5 cm are required for dry rubbing and two for wet rubbing. One specimen of each pair has the long direction parallel to the warp yarns, the other parallel to the weft or filling yarns.

4.2 If the textile to be tested is yarn or thread, knit it into fabric of suitable dimensions (see Paragraph 4.1), or form a layer of parallel strands by wrapping it lengthwise on a cardboard rectangle of suitable dimensions.

4.3 If the textile to be tested is in the form of loose fiber, comb some of it into a mat of fiber of suitable dimensions (Paragraph 4.1) at least 1 cm thick in the uncompressed state. The mat should then be secured to a rectangle of cardboard.

5. Procedure

5.1 DRY RUBBING———With the dry undyed cloth in place over the end of the finger of the testing device, rub it to and fro in a straight line along a track 10 cm (4 in) long on the dry specimen, 10 times in 10 sec, with a downward force on the finger of 900 g (2 lb). Test warp and weft or filling directions separately.

5.2 WET RUBBING———Repeat the test with a fresh dry specimen and undyed cloth which has been wetted with water and squeezed to a take-up or add-on of 100%. Dry the cloths at room temperature.

5.3 Assess the staining of the undyed cloths with the grey scale (see Paragraph 7.3).

6. Report

6.1 Report the numerical rating for dry staining and for wet staining for the direction, warp or weft or filling, showing heavier staining.

7. Notes

7.1 The Crockmeter may be obtained from:

The Calico Printers' Association Ltd, St James's Buildings, Oxford Street, Manchester 1, England.

The American Association of Textile Chemists and Colorists, Lowell Technological Institute, Lowell, Mass, USA.

Walter Thoma, Rheinfelden (Baden) Wehrstr, 6 and Gebrüder Hofmann, Technisches Büro, Rheinfelden (Schweiz).

It is described in the *1944 Year Book, AATCC,* Page 192. Duplex Crockmeters for testing two specimens simultaneously are described in *Am Dyestuff Reptr 36,* 392 (1947).

7.2 Cloth for the purpose may be obtained from:

The Society of Dyers & Colorists, 19, Piccadilly, Bradford 1, Yorkshire, England.

The American Association of Textile Chemists & Colorists, Lowell Technological Institute, Lowell, Mass, USA.

7.3 See the following sections:

a Color fastness of textiles: General principles of testing.

b Color fastness: Grey scale for assessing staining.

Color fastness to soda boiling

1. Purpose and scope

1.1 This method is intended for assessing the resistance of the color of textiles in all forms to the action of boiling dilute sodium carbonate solutions. It is mainly applicable to natural and regenerated cellulose materials.

1.2 Two tests are given, one with and the other without the addition of a reduction inhibitor.

2. Principle

2.1 A specimen of the textile between specified undyed cloths is rolled around a glass rod and treated with boiling sodium carbonate solution with and without the addition of a reduction inhibitor. The composite specimen is rinsed, the cloths are separated and dried, and the change in color of the specimen and the staining of the undyed cloths are assessed with standard grey scales.

3. Apparatus and reagents

3.1 Vessel equipped with water-cooled reflux condenser of the finger type to hold a cylindrical specimen 4 cm long in the boiling solution.

3.2 Glass rod 5-8 mm in diameter.

3.3 Desized undyed cotton fabric.

3.4 Undyed cloth of the type under test (or, if fiber or yarn is being tested, undyed cloth made from the same kind of fiber).

3.5 Sodium carbonate solution containing 10 g anhydrous sodium carbonate per liter.

3.6 Sodium carbonate solution containing 10 g anhydrous sodium carbonate per liter and 4 g sodium *m*-nitrobenzenesulphonate per liter.

3.7 TEST-CONTROL SPECIMENS———Dyeings of Solanthrene Brilliant Pink R Powder (*CI* 1211) (see Paragraph 7.1).

3.8 Grey scales for assessing change in color and staining of undyed cloths (see Paragraph 7.2).

4. Specimen

4.1 Two specimens, prepared as follows, are required.

4.2 If the textile to be tested is fabric, place a specimen of it 10 cm x 4 cm between pieces of the undyed cloths specified in Paragraphs 3.3 and 3.4 and sew along one of the shorter sides.

4.3 If the textile to be tested is yarn, knit it into fabric and treat it as in Paragraph 4.2, or form a layer of parallel lengths of it between the two undyed cloths and sew along one of the shorter sides to hold the yarns in place.

4.4 If the textile to be tested is loose fiber, comb and compress enough of it to form a sheet 10 cm x 4 cm, place it between the two undyed cloths, and sew along one of the shorter sides to hold the fibers in place.

5. Procedure

5.1 Carry out the operation described in Paragraphs 5.2-5.4 inclusive with each specimen and the test-control specimen in parallel in separate baths.

5.2 Roll the composite specimen around the glass rod to form a cylinder 4 cm long and tie it loosely with thread.

5.3 Treat one composite specimen on the rod by boiling gently under reflux for 1 hour in the sodium carbonate solution (Paragraph 3.5) at a liquor ratio of 30:1. Treat the other composite specimen in the same way and for the same time in boiling sodium carbonate solution containing the sodium *m*-nitrobenzenesulfonate (Paragraph 3.6).

5.4 Remove the specimens from the rod immediately, rinse for 10 min in cold, running tapwater, and separate the undyed cloths from them. Dry all pieces in air at a temperature not exceeding 60°C (140°F).

5.5 Assess the effect on the test-control specimens with grey scales. The ratings of a control specimen after boiling with sodium *m*-nitrobenzenesulfonate should be 3-4 weaker, yellower in respect of change is color and 5 in respect of staining. The ratings of a control specimen after boiling without sodium *m*-nitrobenzenesulfonate should be 2-3 weaker, yellower in respect of change in color and 5 in respect of staining. If the control specimens do not yield these values, the test has not been carried out correctly, and the operations described in Paragraphs 5.1-5.4 inclusive must be repeated with fresh composite specimens and fresh composite test-control specimens.

5.6 Assess the changes in color of the specimens and the staining of the undyed cloths with the grey scales (see Paragraph 7.2).

6. Report

6.1 Report the numerical ratings for change in color and the numerical ratings for staining of each kind of undyed cloth tested with sodium carbonate alone and with sodium carbonate and sodium *m*-nitrobenzenesulfonate reduction inhibitor.

7. Notes

7.1 TEST CONTROL———

REDUCTION———3.0% Solanthrene Brilliant Rose R Powder is pasted with 150 times its weight of water using an anionic wetting agent at the rate of 3 ml per g of dye. 40 ml of sodium hydroxide (76° Tw, 36° Bé) and 13 g of sodium dithionite (hydrosulfite) are added per liter and the dye is allowed to reduce for 15 min at 50°C.

DYEING———The dyebath is set at a liquor ratio of 25:1. To it are added 2-3 ml of sodium hydroxide (76° Tw, 36° Bé) and 1 g of sodium dithionite (hydrosulfite) per liter, followed by the calculated amount of reduced dye. The dyeing is started at 30°C, and heat is applied for 15 min to bring the temperature to 60°C. Dyeing is continued at this temperature for 30 min.

The pattern is then oxidized in air, rinsed in cold, running tapwater, soaped at the boil, rinsed in cold, running tapwater and dried.

7.2 See the following sections:

a Color fastness of textiles: General principles of testing.

b Color fastness: Grey scale for assessing change in color.

c Color fastness: Grey scale for assessing staining.

Color fastness to stoving

1. Purpose and scope

1.1 This method is intended for assessing the resistance of the color of textiles of all kinds and in all forms to the action of sulfur dioxide as used for bleaching animal fibers.

2. Principle

2.1 A specimen of the textile containing its own weight of soap solution and a control are exposed in an atmosphere containing sulfur dioxide. The change in color of the specimen is assessed with a standard grey scale.

3. Apparatus and reagent

3.1 Vessel of approx 10-liters capacity for the sulfur dioxide atmosphere.

3.2 Sulfur.

3.3 Soap, containing not more than 5% moisture and complying with the following requirements based upon dry weight:

Free alkali calculated as Na_2CO_3	0.3%
Free alkali calculated as NaOH	0.1%
Combined fatty acids calculated as Na salts	85%
Titre of mixed fatty acids prepared from the soap	30°C
Iodine value	50°C

3.4 Soap solution, containing 5 g of soap (see Paragraph 3.3) per liter of distilled water.

3.5 TEST CONTROL———A dyeing on wool of 2.5% Coomassie Milling Scarlet 5 BS (*CI* 487) (see Paragraph 7.1).

3.6 Grey scale for assessing change in color (see Paragraph 7.2).

4. Specimen

4.1 If the textile to be tested is fabric, a specimen at least 10 cm x 4 cm is required.

4.2 If the textile to be tested is yarn, knit it into fabric and use a specimen at least 10 cm x 4 cm, or from a number of lengths of it form a wick 10 cm long and about 0.5 cm in diameter tied near both ends.

4.3 If the textile to be tested is loose fiber, comb and compress enough of it to form a sheet at least 10 cm x 4 cm.

5. Procedure

5.1 Thoroughly impregnate the specimen and the test-control specimen by immersion for 5 min at 25 ± 2°C (77 ± 4°F) in the soap solution. Then squeeze so that each contains its own weight of solution.

5.2 Suspend the specimen and the test control (see Paragraph 3.5) for 16 hr in the vessel containing an atmosphere of sulfur dioxide, obtained by igniting 5 g of sulfur below the specimen and the control and immediately closing the vessel.

5.3 Remove the specimen and the control from the sulfur dioxide atmosphere, and allow to hang in air for at least 2 hr without rinsing. The specimen and the control are to be examined when dry. If the specimen contains cellulosic fibers, rinse it in cold, running tapwater and dry in air at a temperature not exceeding 60°C (140°F).

5.4 Assess the effect on the test control with the grey scale. If the change is not equal to the contrast illustrated by Grade 3 on the grey scale, the test has not been carried out correctly, and the operations described in Paragraphs 5.1-5.5 inclusive must be repeated with fresh composite specimens and a fresh composite test-control specimen.

5.5 Assess the change in color of the specimen with the grey scale (see Paragraph 7.2).

6. Report

6.1 Report the numerical rating for the color change in the test.

7. Notes

7.1 TEST CONTROL———A well wetted-out pattern of wool cloth is entered at 40°C (104°F) into a dyebath containing 2.5% Coomassie Milling Scarlet 5BS (*CI* 487), 10% sodium sulfate crystals ($Na_2SO_4.10H_2O$), and 3% acetic acid (30%), all percentages being calculated on the weight of the pattern. The liquor ratio is 40:1. The dyebath is raised to the boil in 30 min and boiled for 30 min. If necessary, the dyebath is exhausted by careful addition of 1-3% acetic acid (30%) or 1% sulfuric acid (sp gr 1.84) well diluted with water. The bath is boiled for a further 15 min after addition of the acid. The pattern is then removed, rinsed in cold, running tapwater and dried.

7.2 See the following sections:

a Color fastness of textiles: General principles of testing.

b Color fastness: Grey scale for assessing change in color.

Color fastness to washing: hand washing

1. Purpose and scope

1.1 This method is intended for assessing the resistance of the color of textiles of all kinds and in all forms to the action of soap solutions as used in washing them by hand.

2. Principle

2.1 A specimen of the textile in contact with specified undyed cloths is agitated in a soap solution, rinsed and dried. The change in color of the specimen and the staining of the undyed cloths are assessed with standard grey scales.

3. Apparatus and reagents

3.1 Suitable container with means of agitation (see Paragraph 7.1).

3.2 Soap containing not more than 5% moisture and complying with the following requirements based upon dry weight:

Free alkali calculated as Na_2CO_3	0.3% max
Free alkali calculated as NaOH	0.1% max
Combined fatty acids calculated as Na salts	85% min
Titer of mixed fatty acids prepared from the soap	30°C max

3.3 Soap solution, containing 5 g of soap (see Paragraph 3.2) per liter of distilled water.

3.4 Two undyed cloths, each 10 cm x 4 cm, one piece made of the same kind of fiber as that in the textile to be tested, the second piece made of the fiber indicated below, or as otherwise specified:

If first piece is—	Second piece to be—
cotton	wool
wool	cotton
silk	cotton
linen	wool
viscose rayon	wool
acetate rayon	viscose rayon
polyamide fiber	wool or viscose rayon
polyester fiber	wool

3.5 Grey scales for assessing change in color and staining of undyed cloths (see Paragraph 7.2).

4. Specimen

4.1 If the textile to be tested is fabric, place a specimen of it 10 cm x 4 cm between the two pieces of undyed cloth required in Paragraph 3.4, and sew along all four sides to form a composite specimen.

4.2 If the textile to be tested is yarn, knit it into fabric and treat it as in Paragraph 4.1, or form a layer of parallel lengths of it between the two undyed cloths, and sew around the four sides to hold the yarns in place.

4.3 If the textile to be tested is loose fiber, comb and compress enough of it to form a sheet 10 cm x 4 cm, place it between the two undyed cloths, and sew around the four sides to hold the fibers in place.

5. Procedure

5.1 Agitate the composite specimen continuously for 30 min in the soap solution at 40 ± 2°C (104 ± 4°F) at a liquor ratio of 50:1. If the agitation is by hand, press the specimen every 2 min against the container without removing it from the solution. If mechanical agitation is used (see Paragraph 7.1) the time of treatment, and if necessary the liquor ratio, shall be adjusted to give results identical

with those of the hand test.

5.2 Rinse the composite specimen twice in cold distilled water and then for 10 min in cold, running tapwater. Squeeze it, remove the stitching along three sides, and dry in air at a temperature not above 60°C (140°F), with the three parts in contact only along the one row of stitching.

5.3 Assess the change in color of the specimen and the staining of the undyed cloths with the grey scales (see Paragraph 7.2).

6. Report

6.1 Report the numerical ratings for color change and for staining of each kind of undyed fiber tested.

7. Notes

7.1 A 500-ml beaker or other suitable open container may be used for the test, agitation being by hand with a glass rod flattened at one end. A closed vessel agitated by shaking or tumbling it by hand or a motor-driven machine may be used.

7.2 See the following sections:

a Color fastness of textiles: General principles of testing.
b Color fastness: Grey scale for assessing change in color.
c Color fastness: Grey scale for assessing staining.

Color fastness to water

1. Purpose and scope

1.1 This method is intended for assessing the resistance of the color of textiles of all kinds and in all forms to immersion in water.

2. Principle

2.1 A specimen of the textile in contact with specified undyed cloths is immersed in water, drained, and placed in a Perspirometer or equivalent apparatus (see Paragraph 7.1). The specimen and the undyed cloths are dried separately. The change in color of the specimen and the staining of the undyed cloths are assessed with standard grey scales.

3. Apparatus and reagents

3.1 Perspirometer or equivalent apparatus (see Paragraph 7.1).

3.2 Two undyed cloths each 6.5 cm x 6.5 cm, one piece made of the same kind of fiber as that in the textile to be tested, the second piece made of the fiber indicated below or as otherwise specified (see Paragraph 7.2):

If first piece is—	Second piece to be—
cotton	wool
wool	cotton
silk	cotton
linen	wool
viscose rayon	wool
acetate rayon	viscose rayon
polyamide fiber	wool or viscose rayon
polyester fiber	wool

3.3 Standard grey scales (see Paragraph 7.2).

3.4 Oven maintained at 37 ± 2°C (100 ± 4°F).

4. Specimen

4.1 If the textile to be tested is fabric, place a specimen of it 6.5 cm x 6.5 cm between two pieces of undyed cloths (see Paragraph 3.2), and sew along one side to form a composite specimen.

4.2 If the textile to be tested is yarn, knit it into fabric and treat it as in Paragraph 4.1, or form a layer of parallel lengths of it between the two undyed cloths and sew along two opposite sides near the ends of the yarn to form a composite specimen.

4.3 If the textile to be tested is loose fiber, comb and compress some of it into a sheet 6.5 cm x 6.5 cm in size, place the sheet between the two undyed cloths, and sew along two opposite sides to form a composite specimen.

5. Procedure

5.1 Thoroughly wet the composite specimen in distilled water at room temperature. Pour off the water, and place the composite specimen between two glass plates measuring about 7.5 cm x 6.5 cm under a force of about 4.5 kg (10 lb).

5.2 Place the apparatus containing the composite specimen in the oven for 4 hr at 37 ± 2°C (100 ± 4°F), or leave at room temperature for sufficient time to give equivalent results.

5.3 Separate the specimen and the undyed cloth, and dry them apart in air at a temperature not exceeding 60°C (140°F).

5.4 Assess the change in color of the specimen and the staining of the undyed cloth with the grey scales (see Paragraph 7.2).

6. Report

6.1 Report the numerical rating for color change and the numerical rating for staining of each kind of undyed fiber tested.

7. Notes

7.1 The Perspirometer, developed by the American Association of Textile Chemists and Colorists, is intended for carrying out tests of this kind, but any apparatus giving identical results may be used.

7.2 See the following sections:

a Color fastness of textiles: General principles of testing.
b Color fastness: Grey scale for assessing change in color.
c Color fastness: Grey scale for assessing staining.

Color fastness to sea water

1. Purpose and scope

1.1 This method is intended for assessing the resistance of the color of textiles of all kinds and in all forms to immersion in sea water.

2. Principle

2.1 A specimen of the textile in contact with specified undyed cloths is immersed in a solution containing sodium chloride, drained, and placed in a Perspirometer or equivalent apparatus (see Paragraph 7.1). The specimen and the undyed cloths are dried separately. The change in color of the specimen and the staining of the undyed cloths are assessed with standard grey scales.

3. Apparatus and reagents

3.1 Perspirometer or equivalent apparatus (see Paragraph 7.1).

3.2 Two undyed cloths each 6.5 cm x 6.5 cm, one piece made of the same kind of fiber as that in the textile to be tested, the second piece made of the fiber indicated below or as otherwise specified (see Paragraph 7.2):

If first piece is—	Second piece to be—
cotton	wool
wool	cotton
silk	cotton
linen	wool
viscose rayon	wool
acetate rayon	viscose rayon
polyamide fiber	wool or viscose rayon
polyester fiber	wool

3.3 Solution of distilled water containing 30 g of sodium chloride per liter.

3.4 Standard grey scales (see Paragraph 7.2).

3.5 Oven maintained at 37 ± 2°C (100 ± 4°F).

4. Specimen

4.1 If the textile to be tested is fabric, place a specimen of it 6.5 cm x 6.5 cm between two pieces of undyed cloth (see Paragraph 3.2) and sew along one side to form a composite specimen.

4.2 If the textile to be tested is yarn, knit it into fabric and treat it as in Paragraph 4.1, or form a layer of parallel lengths of it between the two undyed cloths and sew along two opposite sides near the ends of the yarn to form a composite specimen.

4.3 If the textile to be tested is loose fiber, comb and compress some of it into a sheet 6.5 cm x 6.5 cm in size, place the sheet between the two undyed cloths, and sew along two opposite sides to form a composite specimen.

5. Procedure

5.1 Thoroughly wet the composite specimen in the solution (see Paragraph 3.3) at room temperature. Pour off the solution, and place the composite specimen between two glass plates measuring about 7.5 cm x 6.5 cm under a force of about 4.5 kg (10 lb).

5.2 Place the apparatus containing the composite specimen in the over for 4 hr at $37 \pm 2°C$ ($100 \pm 4°F$).

5.3 Separate the specimen and the undyed cloth, and dry them apart in air at a temperature not exceeding 60°C (140°F).

5.4 Assess the change in color of the specimen and the staining of the undyed cloth with the grey scales (see Paragraph 7.2).

6. Report

6.1 Report the numerical rating for color change and the numerical rating for staining of each kind of undyed fiber tested.

7. Notes

7.1 The Perspirometer developed by the American Association of Textile Chemists and Colorists is intended for carrying out tests of this kind, but any apparatus giving identical results may be used.

7.2 See the following sections:

a Color fastness of textiles: General principles of testing.
b Color fastness: Grey scale for assessing change in color.
c Color fastness: Grey scale for assessing staining.

Color fastness to water spotting

1. Purpose and scope

1.1 This method is intended for assessing the resistance of the color of textiles of all kinds and in all forms to spotting by water.

2. Principle

2.1 A droplet of distilled water is worked into the textile with a glass rod, and the change in color of the textile is assessed with a standard grey scale after 2 min and after drying.

3. Apparatus and reagents

3.1 Pipette or dropper to deliver approx 0.15 ml of water.

3.2 Glass rod with rounded end.

3.3 Grey scale for assessing change in color (see Paragraph 7.1).

4. Specimen

4.1 If the textile to be tested is fabric, a piece at least 10 cm x 4 cm is required.

4.2 If the textile to be tested is yarn, knit it into fabric and use a piece at least 10 cm x 4 cm, or make a wick of parallel lengths 10 cm long and about 0.5 cm in diameter, tied near both ends.

4.3 If the textile to be tested is loose fiber, comb and compress some of it into a sheet at least 10 cm x 4 cm in size.

5. Procedure

5.1 Spot the specimen with approx 0.15 ml of distilled water at room temperature. Work the droplet into the specimen with the glass rod.

5.2 After 2 min assess the change in color in the periphery of the spot with the grey scale.

5.3 Dry the specimen in air at room temperature, and assess the change in color with the grey scale.

6. Report

6.1 Report the numerical ratings for change in color after 2 min and after drying.

7. Notes

7.1 See the following sections:

a Color fastness of textiles: General principles of testing (especially Paragraph 9.5).
b Color fastness: Grey scale for assessing change in color.

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THE PRINCIPLES AND PRACTICE OF COLOR STRIPPING*

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This paper considers the hydrosulfite and sulfoxylate types of strippers.

The mechanism of stripping is discussed briefly, followed by a discussion of the practical aspects.

The hydrophilic fibers offer no problem in stripping (provided the dye is dischargeable), while for the hydrophobic fibers it is brought out that diffusion of the stripper into the fiber and corresponding diffusion of the reduction products out of the fiber are important.

THEORETICAL

DURING a stripping operation in which strong reducing agents are used to remove colors from textile fibers, several processes occur simultaneously. Almost all interact with one another, the rate of one partly determining the rates of others. Because of this, and because of the difficulties involved in working with a strongly reactive, two-phase, multicomponent system, no stripping operation has ever been described completely in quantitative terms. It is possible, however to describe the separate processes and indicate in a qualitative fashion their interactions.

In the simplest stripping operation eight processes take place more or less simultaneously:

1) Diffusion of the stripper through the solution.
2) Adsorption of the stripping agent on the fiber surface.
3) Diffusion of the stripper within the fiber.
4) Reduction of the dye by the stripper.
5) Reaction of the stripping agent with reducible substances other than the dye itself.
6) Diffusion of the products of the redox reaction outward.
7) Desorption of the reaction products from the fiber.
8) Partition of the reaction products between the solution and whatever substrates are available.

In the discussion below each of these processes will be considered, and its interaction with the others qualitatively or semiquantitatively, described.

1) DIFFUSION OF THE STRIPPER THROUGH THE SOLUTION——This process is a slow one only under certain laboratory conditions. In actual practice, or in pilot trials, which attempt to emulate field conditions closely, agitation of the stripping liquor or of the textile material is normally sufficiently strong to make this process one of the fastest in the overall stripping operation. Its effect on the subsequent steps may therefore be considered negligible.

2) ADSORPTION OF THE STRIPPER ON THE FIBER SURFACE——The rate of adsorption of a stripping agent by a fiber depends upon: a) the concentration of the stripper in solution — $(S)_{sol}$, and b) how much stripper has already been adsorbed at a given time, t, since any fiber has a definite saturation rate with respect to a stripper — $(S_{sat})_{fib}$. That is,

$$d(S)_{fib}/dt = k_1(S)_{sol}[(S_{sat})_{fib} - (S)_{fib}] \quad \text{(Eq I)}$$

where $(S)_{fib}$ is the concentration of stripper in the fiber at time, t. Sorption processes are reversible, however, and simultaneously with absorption there occurs desorption from the fiber. The rate of desorption is dependent only upon the concentration of stripper in the fiber. That is,

$$-d(S)_{fib}/dt = k_2(S)_{fib} \quad \text{(Eq II)}.$$

To get the observed or overall adsorption rate, the two equations are combined to give

$$\text{observed adsorption rate} = \text{adsorption rate} - \text{desorption rate}$$
$$= k_1(S)_{sol}[(S_{sat})_{fib} - (S)_{fib}] - k_2(S)_{fib} \quad \text{(Eq III)}.$$

At equilibrium — and it is difficult to say when exhaustion equilibrium is established in a stripping — the two rates are equal, the observed rate drops to zero, and the expression reduces to the equation for a Langmuir isotherm. (In this discussion the departures from ideality have been neglected. Corrections for electrical and shape effects, and introduction of activity coefficients would have to be made; the effects of other electrolytes would also have to be taken into account.)

Relative to the other processes involved in the stripping operation, the adsorption of stripper should be rapid. Little competition should be suffered even in the presence of a scavenger or "soluble fiber", since thermal effects make exchange of the low-molecular-weight stripper rapid among available sites, and mass action would favor adsorption on the fiber.

3) DIFFUSION OF THE STRIPPING AGENT WITHIN THE FIBER——Diffusion processes, at least in wet textile operations, are usually assumed to follow the uncorrected statement of Fick's law:

$$ds/dt = -VD.d(S)_i/dx \quad \text{(Eq IV)}$$

where ds/dt is the diffusion rate, V is the fractional volume of "pores" within the fiber, D is the diffusion coefficient, and $d(S)_i/dx$ is the concentration gradient referred to the stripper in solution in the channels or pores within the fiber. (Nonideality is again neglected.) The diffusion coefficient varies with both the molecular weight of the diffusing substance and the inherent permeability of the fiber. (The permeability may be a function, at least in part, of V.)

Since the molecular weight of the diffusing stripper is relatively low, D— and therefore ds/dt as well — depend practically entirely on fiber permeability. With wool, silk and cellulose the permeability is relatively high. With acetate rayon and the newer synthetics it is low. The permeabilities for water are mirrored in the saturation values for the fibers; with the hydrophobics these values lie

* Presented by W C Lindsly before a Symposium on Chemical Agents in Textile Processing, which was held on Sept 24, 1955 in the West Room of the Haddon Hall Hotel, Atlantic City, N J.

well below ten percent; with rayon and the natural fibers they are numbered in several tens of percent.

Whether the diffusion rate is slow or fast, however, it is relatively the slowest of all the simultaneous processes taking place in stripping. It is the rate-controlling process, just as in dyeing, for it limits the overall rate of all subsequent processes in the operation. To speed diffusion and overall stripping rate, therefore, it is necessary to increase the permeability of the fiber. While it has not been found commercially necessary to do this for the natural fibers or rayon, it is almost economically prohibitive *not* to do it with the synthetics.

Toward this end various substances, called carriers or swelling agents, are used. Vickerstaff has classed them into two categories.

The first, or hydrophilic, type are capable of hydrogen bonding with the fiber. In the formation of such bonds, the H-bonds crosslinking the fiber itself are broken and the rigid network of fiber micelles or microcrystallites is disrupted. The pores of the fiber are widened and the fiber made more permeable to water-borne substances. Further, osmotic pressure may come into play here, the carrier being the solute, the fiber the semipermeable membrane, and the water the solvent.

In the second class are the hydrophobic carriers. Since their solubility in water is usually extremely low, osmotic effects can play little part in their action. Moreover, they do not form H-bonds with the fiber. They are adsorbed and are held probably only by weak secondary forces. Nevertheless, they too disrupt the tight molecular network and permit easier ingress of aqueous solutions.

As the low solubility of even some of the hydrophilic carriers causes difficulties in practice, some work was carried out in this laboratory to determine if solubility could be improved without impairing stripping efficiency. Ammonium benzoate was used. It was thought that, at the boil, this salt would liberate the free acid at a rate comparable with the diffusion rate of the acid within the fiber, thus producing an effective strip without running the danger of having the carrier crystallize out in the early stages of the operation. Sodium sulfoxylateformaldehyde was used as the reducing agent as, even at low pH, little reduction is observed below about 150°F. It was hoped that the stripper would become "active", therefore, only when the free carrier acid had begun to be liberated.

Disperse-dyed nylon, Orlon and Dacron were stripped. The results were discouraging, being no better than when no carrier at all was used. The fault probably lay in the low hydrolysis constant of the $C_6H_5COONH_4$, most of the substance remaining in the ionized state even at the boil.

4) REDUCTION OF THE DYE BY THE STRIPPER: 5) REACTION OF THE STRIPPER WITH REDUCIBLE SUBSTANCES OTHER THAN THE DYE ITSELF ——— (Since these two processes are intimately related they will be treated in one section.)

The reduction of the dye by the stripper is, in theory, a fairly fast, second-order oxidation-reduction reaction. The overall rate and extent of dye reduction are affected, however, by two factors.

First, the amount of stripper reacting at any time with the dye is controlled by the diffusion rate of the stripper within the fiber. As was brought out in the previous section, this is a relatively slow process even under the best of conditions, and with the hydrophobics it is very slow indeed.

Second, the total amount of stripper available for reducing the dye is limited by the total quantity of other reducible substances in the system. The main competing reaction is with oxygen, which is dissolved from the air and mechanically beaten into the liquor by agitation. This competition may be serious in certain types of apparatus, eg, in laundry machines.

Increasing the temperature of the liquor diminishes the solubility of oxygen in it. By reducing the amount of dissolved gas, therefore, one should expect to limit the wasteful reaction of it with the stripper. Increasing the temperature also increases the rate of reaction, however, and since the rate increases exponentially while the solubility decreases linearly, the overall effect of increasing temperature is to accelerate the competing reaction. Yet one is forced to use high temperatures, for with the synthetics little or no diffusion takes place much below about 180-200°F.

In this laboratory we investigated the use of proteins as oxygen barriers. Proteins, such as blood albumen, denature on heating and congregate at interfaces. We hoped that such films would slow the diffusion rate of oxygen from the atmosphere to the liquor. With albumens, however, no effect was observed. With high-phosphorous-content proteins, such as casein, which is almost hydrophobic, solubility difficulties would be encountered in the low pH ranges desired for stripping any but the relatively fast-stripping cellulose fibers. The only case in which one need not consider competition from oxygen, then, is the closed system where the oxygen in the goods and the liquor would be consumed in a very few minutes, and where it would not be replaced from the atmosphere.

When a hydrosulfite, rather than a sulfoxylateformaldehyde, is the stripper, one more competing reaction becomes serious. This is auto-oxidation of the hydrosulfite, an internal redox reaction. It takes place in aqueous solutions of such strippers even when oxygen is rigorously excluded from the system. With sulfoxylateformaldehyde there is little auto-oxidation, the HCHO stabilizing the stripper.

In the particular case of the stripping of wool, there is another competing reaction: the disulfide bonds of the keratin can consume a large amount of stripper. Since the cystine links are less readily available in acidic than in basic media, presumably because of their close proximity to acidic residue clusters and proline groups, this side reaction may be minimized by keeping the pH low.

Other reactions are generally of little consequence except in the possible case of the stripping of mordant, metalized or premetalized dyes. In these cases some of the reducing agent would be expended in lowering the oxidation state of the metal. This in itself is not bad since reducing the metal would tend to lower or destroy the stability of the dye-metal-fiber complex and therefore lower the fastness or tinctorial power of the complex. The use of a chelating agent in the bath permanently removes the reduced metal from the broken complex and prevents subsequent reoxidation to its original form.

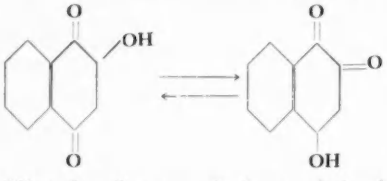
An interesting and important point in stripping, which has been touched upon only empirically, should be brought out here. It has often been the practice of dyers to introduce anthraquinone into a stripping liquor to improve the ground. The function of the anthraquinone has been anything but clear in spite of the fact that the probable basic cause of its effect is well known.

The theory is this. While reduction-oxidation reactions of inorganic compounds may well proceed by two electron jumps, it is now thought that organic redox systems operate by unit electron transfers. Michaelis, in his pioneering work on the catalysis of enzyme redox reactions, was able to show conclusively that certain quinoid dyes are excellent catalysts in respiration processes. These dyes are characterized particularly by the fact that they can exist in three forms: the fully reduced, the completely oxidized, and an intermediate state, which gives rise with the greatest facility to either of the other two on application of the proper conditions.

The change from either the totally reduced or the totally oxidized state to the semiconverted form, and vice versa, takes place by one electron jumps. The intermediate compound exists as a reso-

nating free radical and, as such, has low free energy. (The resonance forms and, therefore, the stability, are pH dependent, free energy being highest near the neutral point.) Thus the resonating compound opens a new pathway for redox reactions between oxidizing and reducing agents, a path whose rate is appreciably higher than that of the simple two-component redox system. The importance of this is that useful reaction of the stripper with the dye may be made more efficient by using a quinone as an intermediary. While the overall rate of dye reduction cannot be speeded beyond the rate of diffusion of the stripper under any circumstances, the instantaneous rate *can* be made more rapid by such a technique and the stripper *within the fiber* can be used more efficiently.

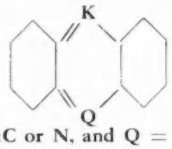
While the possibility exists that the anthraquinone may function merely as a colorless dye in stripping and give a cleaner ground simply by a dilution effect, it seems more likely that its effect is due to its being an intermediate in the redox system. The door is open, therefore, on a new and possibly profitable channel for improving stripping. While anthraquinone itself is of only moderate efficiency, other quinones may offer better tools. For example, nuclear substitution of a quinone affects its redox potential. Groups that facilitate further substitution in the ring lower the E_o, while groups that hinder substitution increase it. Also, hydroxy- and amino-substituted quinones can exist in tautomeric forms of the type:



What the effect on stripping catalysis of such substitution would be may only be guessed at now. Further research alone will tell.

6) DIFFUSION OF THE PRODUCTS OF THE REDOX REACTION OUTWARD——As in the case of the stripper diffusing inward within the fiber, the rate of diffusion of the redox reaction products outward will be slow. The picture is more complex here, however, for the substances diffusing outward are not only the oxidized forms of the stripper (sulfites, sulfates, formaldehyde-bisulfite addition compounds, etc) but the reduced dye or its various moieties. With the oxidized forms of the stripping agent, particles of lower molecular weight would have a more rapid instantaneous diffusion rate; but the overall rate, being limited by the inward diffusion of the stripper, could not exceed the velocity of the latter.

With the dye or its fragments, the appreciably greater molecular weight slows the diffusion rate, sometimes so much that little of the reduced dye diffuses out during the relatively brief period of stripping. In the case of certain color types, notably azos, this would not be of great consequence since azo linkages, —N=N—, are irreversibly reduced during stripping and the chromophoric activity completely destroyed. However, with phenazine, phenoxazine, acridine, phenothiazine and similar groups of the type:



where K = C or N, and Q = N, S or O, the reduction is reversible, the double bond joining Q to the ring opening, but the = K — link remaining intact. On air oxidation the = Q — bond reforms and the color once more appears. Therefore, if an appreciable quantity of the dye is left in the fiber the stripping will be fugitive, color returning on air aging.

With disperse colors of the modified Primuline type, this is especially troublesome. These colors contain two or more thiazole groups as well as azo links. The latter are irreversibly ruptured by reduction, the former reversibly. When such a dye, eg, Setacyl Direct Blue RF (Pr 228), is stripped from acetate, the royal blue color is reduced to a golden yellow. If the stripping is not carried out for a long enough period or at a high enough temperature (and it is difficult to satisfy these two requirements in stripping this dye), much of the dye remains bound within the fiber and slowly reoxidizes to give deepening shades of apple green.

That some chemical or physical fiber interaction may be involved in the reduction or subsequent reoxidation is indicated by the fact that nylon, which dyes to the same shade as acetate with the dye, strips not to a yellow but to a dirty buff, and reoxidizes back to a dull bluish violet instead of a green. Further, heat accelerates the reoxidation on nylon greatly, while with acetate the effect is minor. Exactly what the interaction is, however, is unknown.

7) DESORPTION OF THE REACTION PRODUCTS——The desorption of reaction products should follow an isotherm similar to that for the case of the adsorbing stripper. Since a mixture of products is desorbing, however, one simple function will not serve to describe the entire process. The rates should be relatively rapid.

8) PARTITION OF THE REACTION PRODUCTS——In an ordinary stripping, with no scavenger added, the reaction products should partition themselves between the fiber and the solution in a manner determined by the difference in chemical potentials. This difference in chemical potential, or more properly, the partial molal free energy, may be defined as the tendency of the products to pass from one phase, the fiber or the solution, to the other. It can be expressed as:

$$-\Delta\mu^\circ_1 = RT \ln (dye_{red})_{fib} - RT \ln (dye_{red})_{sol} \quad \text{(Eq V)}$$

where the expressions in parentheses are concentrations. (Ideality again is assumed).

When a scavenger or "soluble fiber", such as polyvinylpyrrolidone, or a quaternary ammonium salt is present in the liquor, the adsorption of the redox reaction products should theoretically be very rapid, at least in the beginning. The behavior should follow a typical adsorption isotherm. Since the rate is actually controlled by the previous steps in the stripping, however, the overall rate of adsorption can be no greater than the limiting fiber diffusion rate.

A near steady state would obtain because the scavenger is present in true or colloidal solution, is of low molecular weight (relative to the fiber), and presents a very large "area" of adsorbing sites. The contribution of the bracketed term in Equation I (referred to scavenger, rather than fiber) would therefore be negligible for a considerable period, the adsorption rate being a function almost entirely of the $(\,)_{sol}$ term. When all the stripper is oxidized, equilibrium would be attained with some reaction products adsorbed on the fiber, some on the scavenger, and some not at all, but free in solution. The relative distribution would again depend upon chemical potentials, two equations defining it — Equation V and the additional one:

$$-\Delta\mu^\circ_1 = RT \ln (dye_{red})_{scav} - RT \ln (dye_{red})_{sol} \quad \text{(Eq VI)}.$$

Some work has been done in this laboratory on the use of unusual types of scavenger systems called coacervates. Coacervates may be of several types, but the kind with which we have worked most is the complex colloid salt type. Such a coacervate consists of clusters or micelles formed by the interaction of two oppositely charged materials, each of relatively high molecular weight.

For instance, one can use a mixture of gelatin and gum arabic at a pH below the isoelectric point of the protein. In this system the positively charged gelatin molecules combine with the negatively charged arabinate chains, forming micelles in which several molecules of each substance are present together with a very large number of water molecules. Depending upon the pH and other variables of the system the micelles can be made to salt out, forming droplets which can be made to grow in size, and eventually coalesce into a separate layer. The internal

phase is in concentration equilibrium with the external, changes in pH in the latter causing charge and concentration changes in the former.

In the stripping of vat dyes from cotton we have used coacervates of widely differing composition. The classical one of gelatin and gum arabic does not function well as a scavenger. Others, however, give good effect, though in most of our investigations we have used concentrations far exceeding those found in the field. Under these conditions some are able to produce much cleaner grounds than orthodox agents, such as polyvinylpyrrolidone. Most coacervates have two disadvantages, however. Many of them tend to produce a slight color of their own on the stripped goods. For example, PVP used as a scavenger in stripping a blue vat from cotton gave a pale blue ground. With certain coacervate systems every trace of dye was removed from the goods but the coacervate itself yielded a faint yellow and not a pure white ground.

The second trouble is that, since at least one component of the coacervate must usually be a high polymer, and since the components are electrically charged, the coacervate or one of its components may exhaust to some degree on the fiber and so modify the hand.

These disadvantages are not necessarily characteristic of every coacervate system, however. Indeed, there is some reason to believe that systems may exist which possess very high adsorptive power and which neither cast shade nor modify hand.

PRACTICAL

Color stripping is carried out a) to remove color from off-shade or streaky goods so that they may be redyed, b) to prepare dyed material for redyeing, as for example, reworked wool or material which has missed a seasonal market and must be put into some other color, and c) to reclaim waste material; for example, clean wipers are salable but bring a better price if white rather than colored.

There are several methods of accomplishing this; among the most common are:

Reduction
Oxidation
Scouring

During a stripping operation in which strong sulfur-containing reducing agents are used to remove color from textile fibers, at least seven of the previously mentioned eight processes occur more or less simultaneously, ie, 2-8.

Of the group, processes 3 and 6 are slowest. They are thus the rate-controlling steps. This is similar to the case of dyeing where adsorption is rapid and diffusion slow, giving rise to ring-dyed fibers in the early periods of the dyeing.

Since diffusion of the stripper into the fiber and diffusion of the reaction products outward depend to a great degree on the inherent permeability of the fiber, an increase in this permeability increases the overall rate of stripping. Substances such as benzoic or salicylic acid, chlorobenzene, phenylphenol, etc, do increase the permeability. They function by disrupting the rigid molecular structure of the fiber, "pushing", as it were, the fiber chains apart and opening up channels through which water-borne substances may more easily pass.

An increase in the speed of the diffusion processes accelerates not only the rate of stripping but also allows a more complete strip to be made. The reason for this becomes obvious when one realizes that, while some of the stripper is doing a job removing color from the fibers, other quantities of the stripping agent are being used up simultaneously by auto-oxidation, oxidation by the air, and by other reducible substances in the system. The rates of these competing reactions are comparatively fast and remain relatively constant. Thus, if the diffusion — and, therefore, overall stripping rate — is increased, while the competing reactions are grossly unaltered in velocity, a smaller absolute quantity of the stripper will be wasted in side reactions.

In many strippings, and especially in the case of the stripping of vats, redeposition and reoxidation of the dye present annoying problems. It is here that "soluble fibers" or other types of color scavengers are often quite useful. When such a substance is present in the reducing bath, the reduced dye will partition itself in three "phases"—on the fiber, in the scavenger, and in the solution. (Unless there is a real phase difference between the scavenger and the solution, they may be considered as one phase.) The degree to which the color is partitioned will depend upon the chemical potential of the reduced dye for the various substrates. Experience indicates the preferred composition to use.

In practice the stripping agent must penetrate the fiber and destroy the dye by chemical reduction. The products of this reaction must then diffuse out of the fiber.

The reducing potential (or stripping power) of the reducing agent as measured in the absence of the fiber is only part of the story. The question is: what is the reducing power after it has penetrated into the fiber? With cotton or rayon, which are easily penetrated, hydrosulfite gives effective stripping. With the hydrophobic fibers, the rate of penetration or diffusion is slower and it is important to use a sulfoxylate, which has greater stability, so that it will retain its efficiency during the time required to penetrate the fiber.

This is illustrated by parallel strippings made on dyed acetate fabric using a) hydrosulfite made alkaline with TSPP and run at 160°F, and b) normal zinc sulfoxylateformaldehyde made acid with formic acid applied at the boil. At the end of thirty minutes at 160°F, the hydrosulfite had decomposed almost completely, yielding only a partial stripping. On the other hand the sulfoxylate, which had been run at the boil for thirty minutes, had partially stripped the color and had a large part of its reducing power left. This stripping was continued for a total time of sixty minutes, and samples taken at fifteen-minute intervals showed that, even though stripping was practically completed in forty-five minutes, some further lightening of the color took place in the last fifteen minutes. The sulfoxylate, because of its heat stability, had retained its reducing power long enough to diffuse into the fiber and there accomplish its work.

There are many dyes which are not affected by reducing agents and some, such as the vat colors, which will reduce to a colorless or to a differently colored product, but which reoxidize to the original shade. These dyes are said to be *discharge-resisting*, and where they have been used, it is impossible to obtain a light ground by stripping. But it is often possible to take off enough color so the material may be redyed satisfactorily.

In practice, it is always a good plan to scour the material before stripping, and in the case of wool yarns or fabrics, it is almost obligatory if level dyeing is expected, since traces of oil left in the material interfere with stripping. Furthermore, for goods of any type which have been finished, it is necessary to remove the finish. This may call for an acid scour in some cases.

For cottons dyed with direct colors, a boil in soda ash is satisfactory followed by stripping with 5% of sodium hydrosulfite owf at about 160°F for 20 minutes.

For vat dyes on cotton, the use of 5% hydro and 5% to 10% caustic soda flakes owf at 160°F will reduce the color and dissolve some of the leuco-vat out of the fiber. When the stripping bath is flooded, some of this will be washed down the drain; however, the process results in a loss of about 10% of the original color on the fiber. A repeat of the process will take off more color, but it is not economical to do this too many times. Therefore, it is sometimes advantageous to use additives to the reduction bath which will couple with, or cause agglomeration of, the leuco particles so that they cannot re-enter the fiber. Materials such as polyvinylpyrrolidone, quaternaries or formaldehyde (37; 0.5% owf) in the case of

indigo have proven useful.

In the case of wool goods dyed with acid or milling colors, a pre-boil with 5% aqua ammonia owf is preferred. This scours the fabric and at the same time removes some color by solvent action.

It has been found that some wool dyes are discharged more readily by one or the other of the sulfoxylate types. The type of dye, the method of dyeing, and the fiber substrate all have an influence. Therefore, if time permits, it is advisable to make laboratory trials to determine the best stripper before starting on a lot of goods.

For lab stripping, 5% sulfoxylate owf adjusted to pH 3.2 to 3.5 is satisfactory. In fact, for subborn cases, two 5% treatments are better than one of 10%.

It is frequently possible in practice, to cut down on the amount of stripper, and 2.5 to 3% usually suffices, even in an open piece-dye box. However, for stripping in a paddle machine or laundry wheel, more stripper is needed, and it is preferable to stop the machine, since air beaten into the liquor oxidizes the stripper rapidly.

Formic acid is the preferred acid since it enhances the heat stability of the sulfoxylate. However, other acids are suitable for pH adjustment and are preferred by some dyers because of the cast of the color after the stripping. For example, formic acid leaves a reddish cast, while [illegible] acid leaves a bluish cast.

2-2.5% formic acid owf is about right. More than this amount will decompose the stripper too rapidly and be detrimental. Of course, for materials which are alkaline due to previous processing, it will be necessary to use sufficient acid to neutralize the alkali and have enough to activate the stripper.

It is general practice to add the acid at the start of the stripping operation in the cold bath, raise the temperature to 120°F, and sprinkle in the dry stripping agent (except basic zinc sulfoxylateformaldehyde, which must be dissolved in dilute formic acid). The temperature is then raised to the boil in twenty minutes and run for the required length of time.

Wool that has been dyed with chrome colors must be boiled with 1 to 2% sulfuric acid owf in order to break the wool-Cr-dye complex and allow the stripping agent to do its work. Even with this drastic treatment, chrome blacks resist stripping.

The addition of sequestering agents to the stripping bath has been found beneficial where wool has been dyed with chrome or metalized dyes.

It is necessary to rinse the goods thoroughly after stripping since stripping agent carried over into the subsequent dyeing will result in dulled shades. For wool goods, some dyers prefer to give a light scour with aqua ammonia following the stripping in order to remove the stripping agent completely. Occasionally, when basic zinc sulfoxylateformaldehyde has been used, it has been found desirable to scour with sodium perborate to remove traces of zinc salts.

It is important to cool the goods slowly after stripping in order to prevent partial oxidation of the reduced dye products present in the liquor. This is accomplished by flooding slowly or by dropping out a small part of the bath with the machine running, refilling with cold water and running for five minutes. This operation is repeated until the liquor is clear and cold.

Silk may be stripped with hydro or sulfoxylate, but it has been reported that it is advisable to avoid the zinc salts to prevent harshening of the silk.

Disperse dyes on acetate and nylon may be stripped with the sulfoxylate stripping agents from 45 to 60 minutes at as close to the boil as the goods will allow. Some disperse dyes are discharged to a pale yellow color, which can be cleared by a second treatment with sodium chlorite. When this chemical is used, the manufacturer's recommendations should be closely followed.

Many colors on Dacron may be stripped with sodium sulfoxylateformaldehyde plus a swelling agent, followed by sodium chlorite in a separate bath. Orlon that has been dyed by the cuprous-ion method may be stripped with sulfoxylate under mild acid conditions. Fibers which are dyed under pressure may be stripped under pressure.

Dyeings on the other synthetic fibers do not respond well to the reducing agents, and other methods of stripping must be used.

CONCLUSION

Diffusibility plays a large part in the stripping of dyes, especially from hydrophobic fibers. For fibers that are easily wet out and into which the stripping agent can diffuse readily, a relatively unstable stripping agent, such as hydro, can be used. For fibers which are difficult to wet out and penetrate, a stripping agent having good stability or "staying power" must be used.

Stripping can be carried out at temperatures, time intervals and pH levels suited to the stripping agent and the goods being stripped.

ACKNOWLEDGMENTS

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QUESTIONS AND ANSWERS

QUESTION: Do you find that the use of wetting agents or emulsifiers and detergents speeds up the stripping or results in a better white?

ANSWER: Even for thoroughly scoured goods that go into the stripping bath wet, a wetting agent — a penetrant — is likely to be helpful.

Q: Can spun-dyed or dope-dyed fibers be stripped?

A (Hector C Borghetty): These fibers are usually dyed with pigments, and the difficulty of stripping is very great.

Q: The use of chelates has been stressed where they would be helpful in reducing dyes containing metal complexes. Would the speaker care to comment on the use of the new chelating agents in that respect?

A: It has been tried. A chelating agent which will tie up chromium is helpful in stripping chrome dyes or metalized dyes from wool.

Back numbers of American Dyestuff Reporter less than two years old may be obtained from Howes Publishing Co, Inc, 44 East 23rd St, New York 10, N Y at the following prices: 50¢ each; $7.50 for a complete volume.

Earlier numbers may be obtained from the Secretary, American Association of Textile Chemists and Colorists, P O Box 28, Lowell, Mass. Prices postpaid: 50¢ each to nonmembers of AATCC, 35¢ to members; complete volumes $5.25 to nonmembers, $4.50 to members.

ACTIVITIES OF THE LOCAL SECTIONS

MID-WEST

THE winter meeting of the Mid-West Section, held Feb 11, 1956 at the Bismarck Hotel, Chicago, Ill, attracted 76 to the afternoon session and 88 to the evening session.

Vice chairman Samuel Littlejohn, Munsingwear, Inc, introduced the afternoon speaker, Walter Ridley, manager, Textile Industries Div, Foxboro Co, who spoke on "Instrumentation—An Integral Part of Dyeing and Finishing".

The evening speaker, Jason M Salsbury, manager of the Textile Resin Research Section, American Cyanamid Co, was introduced by chairman Arthur I Hultberg, Bear Brand Hosiery. Dr Salsbury's paper, "A Summary of Soil-resistant Treatment of Fabrics", was supplemented with slides and illustrations.

It was announced at the meeting that Elliott Morrill, The Best Foods, Inc, would serve as chairman of the 1958 AATCC Convention, which will be held at the Conrad Hilton Hotel, Chicago, Ill in September of that year.

Mr Morrill, chairman of the Section's Scholarship Committee, reported that the Committee now has six applications to act upon.

The composition of two Sectional Committees was announced as follows:

Stream Pollution Committee———J Crane, chairman; R C Anderson, L G Johnston, F H Proudfoot, C W Wille.

Outing Committee———Edwin Sindt, chairman; A Andrews, W Boyd, F Beverly, V Braun, H Ericson, K Harms, L Miller, R Lueg, L Voss.

A report of the January Council meeting was given by Eric Camp.

Chairman Hultberg introduced Thomas R Scanlan, Jr, national vice chairman of publicity, who attended the meeting as a guest.

NEW YORK

A MEETING of the New York Section was held on Friday evening, January 27th, at the Hotel Delmonico, New York. Edmund A Leonard, vice chairman, presided in the absence of John H Hennessey, chairman.

Mr Leonard made reference to the passing of George L Baxter. He also called attention to the fact that three members of the Section had retired at the end of the year: Daniel P Knowland, Joseph S Lange and Carl A Puller. Henry F Herrmann, representing the President's Advisory Committee, spoke about the impending retirement of Dr H C Chapin and the illness of Albert E Sampson and pointed out the necessity for an administrative officer of the AATCC. President Raymond W Jacoby spoke on the plans for the Perkin Centennial. Guests from Philadelphia, introduced by Mr Leonard were: Fred V Traut, regional vice president, and Thomas H Hart, Edward C Diehl and Thomas R Scanlan, Jr, officers of the Philadelphia Section.

George F Jones, supervisor of the Textile and Special Products Research Laboratory of Imperial Paper and Color Corporation discussed "Pigments for Textiles" and illustrated his paper with slides.

The attendance was 370.

PHILADELPHIA

THE Philadelphia Section will hold its annual "Ladies' Night" meeting on April 20th at the Benjamin Franklin Hotel, 9th and Chestnut Streets, Philadelphia, Pa, beginning at 6:30 pm. Many special events are planned with corsages for the ladies, and Larry Ferrari of WFIL-TV at his Hammond organ for dinner music.

The highlight of the evening will be a Fashion Show, presented by Aberfoyle of New York. The show will illustrate new fall fabrics by leading American designers in women's, men's and children's wear. These fabrics will be created from new yarns in high fashion cottons, cotton with silk and distinctive blends of the newer synthetics.

Many of these designs will be presented in fabrics that have not been seen before. The new fabric developments will illustrate the creative originality of the best of design in the fashion world as well as improvements in colors and finishes which have been and are currently being developed.

All tickets must be obtained on an advance sale basis and may be secured by writing to the Dining Chairman, Globe Dye Works Co, 4500 Worth Street, Philadelphia 24, Pa.

RHODE ISLAND

THE Rhode Island Section met February 23rd at Johnson's Hummocks Grill, Providence, R I, to hear D D and Leslie Tillet, authorities in the field of textile designing, discuss "Aesthetic Standards in Textile Print Designs".

At present Mr and Mrs Tillet are copartners of the House of T Fabrics, where they design and print drapery fabrics of cotton, linen and fierglass for the decorative trade.

Mr Tillett studied textile designing in his native England as well as in Italy and the United States. In addition to being a consultant designer to Riegel Textiles, Golding Bros, Sidney Blumenthal & Co, Inc, and Leacock & Co, he has been at times design director of colored yarn worsteds, printed woolens, cottons and silks for women's wear for Honora Fabrics Co, and studio director of printed cottons, silks and woven worsteds for the men's wear trade for Laureling Fabrics, Inc.

Mrs Tillett, formerly assistant to the art director of *Harper's Bazaar*, joined her husband in a discussion of the methods currently used to originate new designs, current standards in print designs and a review of some ways and means of improving aesthetic standards.

R F Caroselli, section chairman, announced that the plans for the Student Night program to be held in April were progressing very well under the direction of James Shore.

SOUTHEASTERN

THE largest attendance in its history was chalked up by the Southeastern Section on February 8th, as 146 members were attracted to a three-site meeting in Alabama. Roger Gill, Pepperell Mfg Co, was in charge.

James C Farrow, professor of chemistry at Alabama Polytechnic Institute, Auburn, Ala, assisted by students, conducted the group on a tour of the college's Textile Department.

Homer M Carter, general manager of Pepperell Mfg Co, Pepperell, Ala, assisted by Burt G Hill, Cecil B Ray, Robert

W Price and Elwood Barbre, all of Pepperell, offered the members a tour of the plant.

At the technical session, Geoffrey V Lund, Courtaulds (Alabama), Inc, Mobile, Ala, discussed "Spun-Colored Fibers", their advantages, limitations, application and future place in the textile economy.

John C Cook reported on the January Council meeting in New York, after which he introduced Walter M Scott, AATCC vice president—Central Atlantic Region, who discussed preliminary plans for the forthcoming Perkin Centennial.

Following a social hour, the attending members assembled for dinner at the Clement Hotel, Opelika, Ala, where Prof Farrow, who recently completed the organization of an AATCC student Chapter at Alabama Polytechnic Institute, was introduced along with the members of the new chapter.

Plans for future meetings during 1956 were completed.

WESTERN NEW ENGLAND

A MEETING of the Western New England Section was held at Rapp's Restaurant, Shelton, Connecticut on January 27, 1956.

The guest speaker at this meeting was Daniel Sassi of Interchemical Corporation, who presented a talk, illustrated with slides, on "A Practical Method of Identification of Textile Fibers in Blends."

Approximately 40 members and guests attended the meeting.

Minutes——

199th COUNCIL MEETING

THE Council held its 199th meeting in the Hotel Statler, New York, N Y, on Friday morning, November 18, 1955. Present were President Raymond W Jacoby presiding; Joseph H Jones, George O Linberg and Walter M Scott, vice presidents; Albert E Sampson, treasurer; Leonard S Little, chairman of the Executive Committee on Research; J Robert Bonnar, Carl Z Draves, Henry F Herrmann and P J Wood, past presidents; Roland E Derby, Jr, Ernest R Kaswell and John P Ploubides representing Northern England; Francis H Casey, Edward H Gamble, Thorwald Larson and Edward W Lawrence representing Rhode Island; Rudolph C Geering representing Western New England; Bernard K Easton representing Niagara Frontier; Irwin J Smith representing Hudson-Mohawk; William F Brommelsick, Charles W Dorn, Herman E Hager, Patrick J Kennedy, Edmund A Leonard and Donald E Marnon representing New York; Carleton T Anderson, Thomas R Scanlan, Jr, Clarence A Seibert, Frederick V Traut and Jackson A Woodruff representing Philadelphia; Harley Y Jennings, Raphael E Rupp and Henry A Rutherford representing Piedmont; Joe D Mosheim representing South Central; Hubert A Desmarais representing Pacific Northwest; James A Doyle of the Publicity Committee; William A Holst of the Committee on Constitution and Bylaws; Albert E Johnson of the Corporation Membership Committee, Harold W Stiegler, director of research; Charles A Whitehead, managing editor of the *Dyestuff Reporter;* and Harold C Chapin and Richard R Frey of the secretary's office.

The secretary's report of the 198th Council meeting and financial report of October 27, and the treasurer's report of November 8, were accepted. The treasurer asked and received approval for purchase of fourteen additional shares of Commonwealth Edison on rights. Addition of $500 to the appropriation for light-fastness standards was approved.

The proposal of the Corporate Membership Committee, approved by the Committee on Constitution and Bylaws, for revision of the Bylaw on Corporate dues, was referred back to the Committee on Constitution and Bylaws for reconsideration and report at the next meeting.

For the Committee on *Colour Index* Marketing Mr Holst predicted publication near the end of the year 1956. Mr Sampson reported favorable response from a general letter to prepaid subscribers explaining the delay.

Vice presidents Jones, Linberg, and Scott described activities in their respective Regions, with particular reference to meetings of the two Sections on the Pacific Coast attended by Mr Jones. Dr Scott discussed contacts of interest to the Association at a recent conference of cotton manufacturers abroad.

Reporting for the President's Advisory Committee, Mr Bonnar said that plans for extensive reorganization of Association management were under consideration but not yet ready for presentation.

Mr Little reported progress in revising descriptions of test methods for more exact detail, and in organization of Sectional research committees. Meetings of ISO committees in September would culminate in an International Day on Monday of Perkin Centennial Week. Mr Johnson reported encouraging increase in Corporate memberships, and plans for soliciting larger contributions through a

SECRETARY'S FINANCIAL REPORT—OCTOBER 27, 1955

	Applications	*Dues, regular & reinstate*	*Dues, Corporate & Sustaining*	*Miscellaneous*	*Totals*
Received & transmitted to Treasurer, August 1 to October 27, 1955	1345.00	22355.00	3250.00	3247.46	30197.46
Leaving deposited by Treasurer with Secretary					6704.11

Miscellaneous items,

Reporters and reprints	96.10
Year Books	320.00
Crockmeters	737.01
Crock cloth commissions	192.03
Multifiber cloth commissions	679.10
Moth cloth commissions	40.00
Water test apparatus	198.14
Dyed standards	26.00
Knitted tubing	14.00
Gas fading units	9.00
Buttons	5.00
Color transfer charts	195.00
Flammability blueprints	5.00
Analytical Methods, unbound	15.00
Application of Vat Dyes	323.00
Cotton skeins, commissions	9.25
Standard grease wool	160.00
Laboratory supplies returned for credit	167.50
Grey scales	55.33
Gas fading	1.00
	3247.46

H C CHAPIN
Secretary

new dues schedule in December. He proposed a new certificate framed in plastic for Corporate members.

Dr Jennings reported on activities in the Piedmont Section, particularly on an annual meeting attended by 300, and a well organized research committee. The recently established Charles H Stone Foundation will award scholarships to students in North Carolina State College and Clemson College. Professor Rutherford deplored lack of students in textile courses, despite scholarships and inducements from local industry. Mr Traut said that eighty were enrolled in another extension course at the Philadelphia Textile Institute under auspices of the Philadelphia Section.

Mr Whitehead reported for Professor Theel of the Publications Committee. To speed publication, authors of papers for future conventions would be asked to submit copies at a specified date in advance of each convention. It was recommended, and voted by the Council, that the President appoint a committee to draft a resolution against commercial advertising in papers. Delivery of a paper before a meeting of the Association or one of its Sections does not insure publication; and a paper not so delivered may, nevertheless, be offered for publication under Proceedings. An Editorial Advisory Board will be appointed by the Publications Committee. Professor Theel is resigning as Chairman of that Committee, and Dr Draves as Editor of Proceedings. Both were voted the thanks of the Council for long service. Files were accumulating for Mr Babey's new Subject and Speakers Bureau.

For organization and operation of the Committee on Inter-Society Relations, Mr Herrmann proposed and received approval of the following:

Method of appointment: Appointees shall be nominated by the President, with the concurrence of ECR, and confirmed by the Council. The Chairman shall be a Past President of the Association. The incumbent President shall be a member ex-officio. The term of service of each member of the Committee shall not exceed five consecutive years. Initial appointments shall be staggered to provide rotating expiration of terms of service.

Duties: To establish and provide on a continuing basis a proper representation of AATCC in the activities of fellow scientific societies in which we have areas of common interest; and vice versa, to establish a contacting point for reciprocal representation in the affairs of AATCC by such fellow societies. A list of societies eligible for such contacts is given, but this may be enlarged or curtailed at the discretion of the Committee.

Authorities: Of necessity the authority of delegates must be defined and, in most instances, restricted to logical limits; having in mind particularly actions by word or vote which commit the AATCC to a course of action or to a concurrence with a fellow society's plan of action for which action by a vote of the Council is warranted. In view of the fact that a defining of authority will differ with each outside society contact, it shall be the first duty of the new Committee to prepare and document appropriate data on the subject, to be submitted to the Council as soon as possible for its sanction.

A list of official delegates to all committees of other societies together with their authorities (voting, or nonvoting and advisory only) is to be published each year in the Technical Manual and Year Book.

For the Atlantic City Convention Mr Traut reported successful financing and record attendance of 1385 members, 233 ladies as their guests, 249 nonmembers and 167 others employed by exhibitors. Thanks were voted to Mr Traut and his committee.

Mr Doyle reported on publicity for the Convention and Year Book, and plans for general publicity based on results from a clipping service. He presented a report from Mr Scanlan, Chairman of the Philadelphia Committee on Publicity for the Atlantic City Convention. This gave a time schedule of releases on various subjects, together with an address list of the recipients, which should be of value to future conventions.

Mr Linberg reported for the Committee on Conventions, presenting a program of Perkin Centennial papers from various participating societies. Mr Kaswell will arrange the schedule of hours and places. Mr Herrmann described the four proposed groups of exhibits, "A More Colorful World," "A Galaxy of Fibers and Materials," "Functional Finishes," and "Testing Equipment Developed by AATCC." Under auspices of the National Retail Dry Goods Association, with cooperation of the Good Housekeeping Institute, Mr Dorn is arranging a demonstration of the development of color, and color fastness, in wearing apparel. This may be broadcast through television.

In support of an invitation now under consideration by the Committee on Conventions, Mr Easton presented the attractions of Buffalo for a convention in 1960, following Boston in 1957, Chicago in 1958 and Washington in 1959. The invitation from Buffalo was referred to the Committee on Conventions.

Presented by Mr Jones for the Committee on Membership and Local Sections, each of the following was elected to the class of membership specified:

CORPORATE

Conover Knitting Co
Desert Sunshine Exposure Tests
Dorr Woolen Co
E F Drew & Co, Inc
Hoffner Rayon Co
Metro Dyestuff Corp
Philip Wick Co, Inc
Rodney Hunt Machine Co
The Stearns & Foster Co
Stein, Hall & Co, Inc
Testfabrics, Inc
Treplow Products, Inc
Virginia-Carolina Chemical Corp
Wyandotte Worsted Co

SENIOR

W T Anasovich, G B Anderson, S N Burmer, G Cale, W E Farmer, H C Feustel, L M Franck, T D Fulmer, M J Hara, J Hiller, B F Johnson, Jr, M B Landis, K G Lay, J A Leddy, T P Lee, W W Leichman, M E Mangarelli, F Magnussen, C Q Miller, S M Rankin, R E Riley, F W Schmidt, H Y Simerson, A J Simonson, S Sterman, L J Stuckens, S A Tassoff, J L Volk, T F Walsh, R H Walter, R D Ward, W H A Weber, Jr, W R Wooldridge, E N Zeuner, Jr.

JUNIOR

P C Blackston, J S Birch, R G Eddy, W A Geiler, L F Harrington, M G Hemming, B L Holmes, J Knup, III, A M Luebbing, L J Reynolds, V A VanSant, D K Viafora.

ASSOCIATE

J M Allan, H B Aylward, A Beardsley, R J Borgersen, L Bay, 2nd, G S Chiaramonte, R A Coderre, J P Ewing, R A Feis, S Hayase, B Knudsen, W L Poole, W N Rand, Y A Setty, M W Shaw, R E Templeton.

STUDENT

C W Baker, R N Berrier, J Blanchette, R A Brandt, R L Comeau, T C Cox, J T Davies, C B DeGreen, V H Garrou, I Greschler, D R Harkey, C W Hollis, R E Howe, R C Jordan, W R Killen, J V Linn, Jr, R L Luckenbach, B A Malmstrom, C F Mauney, K L McKinney, C F Nimmo, V T Novak, G A Pope, F M Rawicz, M L Ricard, H W Saffer, J E Sipes, N E Veys, K C Williamson.

TRANSFERRED FROM OTHER CLASSIFICATIONS TO SENIOR

E Charves, D R Christie, E D Fenton, R P Jacobs, W J Kennedy, D N Koenig, A Mafilios, N A Matlin, J McLuckie, Jr, H J Northup, P N Robinette, J W Romine, J E Thornton.

Respectfully submitted,
H C CHAPIN
Secretary

Perkin Centennial Notes

THE PERKIN CENTENNIAL

RAYMOND W JACOBY

Chairman
Perkin Centennial Executive Committee

IN 1856 a young chemistry student in England, William H Perkin, was conducting an experiment in his home laboratory in an effort to produce synthetic [illegible]. At that time the British Empire was expanding throughout the world, and quinine was of vital importance as their countrymen were serving in the tropics and sub-tropics. At the completion of this experiment he had some violet-colored crystals and his effort to produce quinine was a failure. Being of an inquisitive nature, he decided to investigate these violet-colored crystals and found that they would dye cloth. So, although his effort to produce quinine was a failure, he had made a synthetic dye.

Knowing man's inherent desire for color, which up to then could be satisfied only with products of nature, he realized the importance of his discovery. He gave up his studies and, with the backing of his father, he undertook to produce this dye commercially. Thus, the synthetic dye industry was started, and subsequent study resulted in other dyes being made. The growth of this infant industry continued through the years and now we have several thousand synthetic dyes in commercial production.

In November 1952 the National Convention Committee of the AATCC had a meeting. Plans had been formulated for the Annual Conventions of 1953, 1954 and 1955, and the question was raised as to the 1956 Convention. It was suggested that instead of having an Annual Convention as such, the 100th Anniversary of this momentous discovery be observed by a Centennial Program, in which other professional societies would be invited to participate. This idea had the enthusiastic support of the Committee and it was decided to make this recommendation at the Meeting of the Council in January 1953. This was done. The Council expressed its approval of the idea and appointed a committee to study the subject and report at the April meeting.

On October 6th, 1906 the American Chemical Society, in collaboration with the American Section of the Society of Chemical Industry, gave a dinner at Delmonico's in New York, "in honor of Sir William Henry Perkin by his American Friends to commemorate the 50th Anniversary of his discovery of the dyestuff Mauve." Sir William was alive and attended the dinner.

In 1906 the AATCC was not in existence. Inasmuch as these two Societies had observed the Golden Anniversary of Perkin's discovery, the Committee thought that the AATCC should not consider sponsoring a Perkin Centennial without first consulting them. Accordingly, the Committee communicated with the President of the American Chemical Society and the Chairman of the American Section of the Society of Chemical Industry, advising them that we were aware of their observance of the Golden Anniversary of Perkin's discovery, and that, if they were not planning an observance of the 100th Anniversary, the American Association of the Textile Chemists and Colorists would consider developing a special program in honor of the occasion. Both Societies replied that they considered that the AATCC, an Association devoted to color, was the logical one to sponsor such a Centennial observance.

The special Committee appointed to investigate the project went ahead with their study and drew up the following proposal, which was submitted to the Council at their April 1953 Meeting and was approved by them:

1) The AATCC to sponsor a Perkin Centennial in the Fall of 1956.
2) Other professional societies to be invited to participate.
3) A comprehensive program to be developed, of which the Annual AATCC Convention would be a part. There would be no separate Convention as such.
4) The Centennial to be conducted on a National rather than on a Regional or Sectional basis, and to be under the direction of a National Perkin Centennial Committee.
5) The Centennial to be held at the Waldorf-Astoria Hotel, New York.

After this official action of the Council, a Perkin Centennial Executive Committee was appointed and started to function.

The successive steps taken by this Committee were as follows:

1) A list of the various topics which would comprise the entire Centennial Program was decided upon.
2) Various Societies were invited to participate and to sponsor certain topics. Each Society to have complete jurisdiction over the topic which they sponsored. This included subjects of papers to be presented, authors, length of time of presentation, etc.
3) As the different Societies received approval from their governing body to participate, they were requested to appoint an Official Delegate who would become a member of the General Committee and represent that Society at the Committee Meetings.

The response to these invitations was unanimous and enthusiastic. The outcome was twenty-four topics sponsored by twenty-seven Societies and two U. S. Government Departments.

The General Committee, organized as above, proceeded to plan for all the details involved. Chairmen of the following Committees were appointed:

Dining and Banquet
Education
Entertainment
Exhibits
General Program
Ladies
Printing
Publicity
Reception
Registration and Reservation
Technical Program (AATCC Convention part of Program)

It was voted that all papers presented during the Centennial be assembled and published in one volume to be known as. . . .

"Proceedings of the Perkin Centennial," a copy of the Proceedings to go to each registrant.

An Editor of the Proceedings was appointed.

Each Committee Chairman is responsible for the organization of his Committee.

As each Committee was organized, it proceeded to make plans to arrange for the various items which come under its jurisdiction.

The progress of these Committees and other activities of the Executive Committee will be detailed in subsequent reports.

News of the Trade

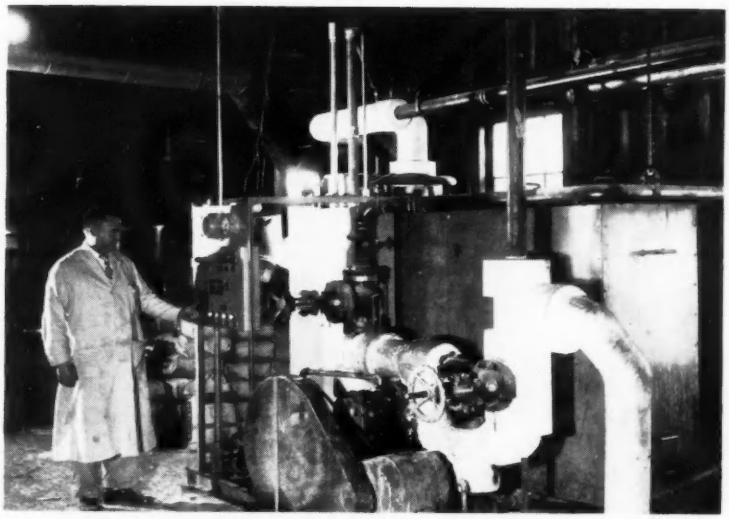
• Bryant Installs New High-Temp Equipment

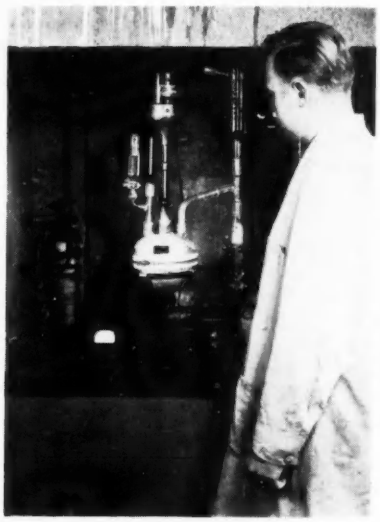
Bryant Chemical Corp, North Quincy, Mass, has installed the newest type of high-temperature equipment in its laboratories and manufacturing plant.

The laboratory equipment facilitates experimental work, development and testing of resins, softeners, detergents and synthetic waxes being introduced to the finishing trade. The laboratory specializes in the development of specialty chemicals to meet the specific requirements of individual plants.

The new, high-temperature, electrically heated and controlled stainless-steel processing equipment in the plant makes possible production of specialties not otherwise obtainable.

In addition to the development facilities, a plant laboratory maintains careful control of all production.





Three views of some of Bryant Chemical Corp's new high-temperature equipment

• Becco Announces Ultra-Rapid Cotton Bleaching Process

The Becco Chemical Division, Food Machinery and Chemical Corporation, Buffalo, N Y, has announced the development of a procedure for ultra-rapid hydrogen peroxide bleaching of cotton fabrics in open width. This "flash-bleaching" procedure reportedly will enable a finishing plant to bleach cotton fabrics of various weights and constructions in a matter of minutes. Conventional bleaching methods normally require a dwell of from one to 1½ hours in the J boxes of continuous peroxide bleaching ranges, and from four to six hours in kier bleaching. The new Becco process will be ready for its first commercial installation upon the completion of special equipment which is now being developed.

The new process will be of interest to wet finishers of fabrics, such as sateens, poplins, twills and others, which are normally processed open width.

• Colgate-Palmolive Displays New Mobile Research Unit

Colgate-Palmolive Co, which is now occupying new offices in the Colgate-Palmolive Building, 300 Park Ave, New York 22, N Y, has introduced the Colgate Launder-Lab Cruiser, a unique mobile research unit.

Outwardly resembling a transcontinental bus, the interior of the Cruiser contains modern laundry equipment and advanced scientific instruments for the evaluation of soap and detergent products. The unit allows the Company to take complete laboratory and testing facilities anywhere in the United States, practically at the doorstep, and study the performance of its products with the water supply, typical soil, and typical fabrics of any community.

The Cruiser is said to be able to operate efficiently and comfortably in any climate in the U S—from winter in North Dakota to summer in the Arizona desert.

• New Cravenette Agent

Clarence Worsted Co, Passaic, N J, is the latest authorized agent to be appointed by The Cravenette Co, USA, Hoboken, N J.

Clarence Worsted Co is licensed and qualified in the application of "Cravenette" Super Silicone finishes to woolen and worsted fabrics, as well as wool and worsted blends containing either Dacron or the acrylic fibers. In addition they may also apply Antara Chemical's Eulan NKU moth repellent. This is done in combination with the silicone and both finishes are durable to drycleaning and laundering.

• Course in Textile and Testing Techniques

The 19th Annual Refresher Course in Textiles and Testing Techniques (s-275), which will be conducted during the first half of the Teachers College Summer Session, Columbia University, July 9-26, will be held at the United States Testing Company's main laboratories in Hoboken, N J. This marks the 7th year Teachers College has accredited the course for 3 points credit toward a degree.

This comprehensive three-week course is open to representatives in the fields of home economics, education, retailing and others who have had some elementary textile training. Through lectures, demonstrations and elective practice sessions, students will cover all phases of analyses on textiles and related merchandise, identification of fibers, chemistry, detergency and research. Special emphasis will be given to new fibers and fabrics.

Classes will be in session from 9:00 am to 4:00 pm from July 9 through 27. In addition, three days, July 30-August 1, are scheduled with special elective field trips for interested class members. For further information and application forms, write to: Ruth Holmes Little, director, Consumer Service Group, United States Testing Company, Inc, 1415 Park Avenue, Hoboken, N J.

There is an urgent need for chemists in the Washington, D C, area, the United States Civil Service Commission has announced. Vacancies are in various Federal agencies and pay salaries ranging from $4,345 to $11,610 a year.

To qualify for positions paying $4,345 a year, applicants must have had appropriate education or a combination of education and experience. For higher-grade positions, professional experience is also required. Graduate study may be substituted for all or part of this experience, depending on the grade of position. No written test is required.

Further information and application forms may be obtained at many post offices throughout the country, or by writing to the U S Civil Service Commission, Washington 25, D. C. Applicants should ask for Announcement No. 46(B). Applications will be accepted by the Board of U S Civil Service Examiners, National Bureau of Standards, Washington 25, D C, until further notice.

• New Name for Haas Miller Corp

Harry Miller Corporation is the new name of the twenty-year-old chemical manufacturing firm formerly known as Haas Miller Corporation. This firm, located at 4th & Bristol Streets, Philadelphia 40, Pa, has developed and is currently manufacturing and marketing chemical products, including Fibregard, which is used to treat synthetic and natural fibers and which has many applications in the textile processing industry.

• Demand on LTI Placement Bureau Still Heavy in Textiles

A total of 216 industrial companies with 297 positions to offer alumni of the Institute contacted the Lowell Technological Institute Placement Bureau between last Aug 31 and Jan 31, according to a recent announcement by Prof James W Bell, placement director. These do not include the more than 80 companies which already have expressed interest in the class to be graduated in June.

Although there was considerable demand for engineers graduated in the newer areas of specialization of the Institute—paper and leather, the largest number of requests still came from the textile field with 32% of the offers made for textile sales, 31% for textile engineers and textile manufacturers, and 31% for textile chemists.

Twenty-eight percent of the 216 companies seeking LTI graduate engineers or chemists are located in Massachusetts. Geographical distribution of the firms follows: New England, 44.9%; Middle Atlantic states, 36.8%; Midwest states, 7.8%; West, 9%; South, 6.9%; foreign countries, 2.7%.

GENERAL CALENDAR

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

Gordon Research Conferences—Textiles Program, July 9-13, Colby Junior College, New London, N H.

AMERICAN SOCIETY FOR TESTING MATERIALS

Mar 13-16—Spring Meeting of Committee D-13 on Textiles, Warwick Hotel, New York, N Y; June 17-22—59th Annual Meeting and 12th Apparatus Exhibit, Chalfonte-Haddon Hall, Atlantic City, N J; Sept 16-22—2nd Pacific Area National Meeting and Apparatus Exhibit, Hotel Statler, Los Ange/es, Calif; Oct 16-19—Fall Meeting of Committee D-13 on Textiles, Warwick Hotel, New York, N Y.

ASSOCIATION OF BRITISH CHEMICAL MANUFACTURERS

Chemical Display (as part of British Industries Fair)—April 23-May 4, Olympia Hall, London, England.

DELTA KAPPA PHI FRATERNITY

32nd National Convention—April 27-28, Georgia Institute of Technology, Atlanta, Ga.

THE DRYSALTERS CLUB OF NEW ENGLAND

May 4 (Hotel Vendome, Boston, Mass); June 22 (Outing, Wachusett Country Club, West Boylston, Mass)

THE FIBER SOCIETY

Spring Meeting—May 2-3, The Clemson House, Clemson, S C; Fall Meeting—Sept 6-7, Warwick Hotel, New York, N Y.

THE INSTRUMENT SOCIETY OF AMERICA

11th Annual Instrumentation-Automation Conference and Exhibit—Sept 17-21, New York Coliseum, New York, N Y

LOWELL TECHNOLOGICAL INSTITUTE

May 10 (Textile Education and Machinery Day, American Textile Machinery Association annual meeting); May 19 (Alumni Day); June 17—Baccalaureate and Commencement Activities); Sept 26-28 (Perkin Centennial observance and open house). All events on campus at Lowell, Mass.

PERKIN CENTENARY

May, 1956—London, England.

PERKIN CENTENNIAL

September 10-15, Waldorf-Astoria Hotel, New York, N Y.

PHI PSI FRATERNITY

Annual Meeting—April 19-21, Alabama Polytechnic Institute, Auburn, Ala.

PHILADELPHIA TEXTILE INSTITUTE

June 14 (Annual Meeting and Clambake—6 pm—College Campus, Germantown, Pa); June 15 (Outing—Manufacturers Golf & Country Club, Oreland, Pa); June 16 (Commencement—College Campus—11 am).

THE QUARTERMASTER ASSOCIATION

Annual Convention—Oct 27-28, Conrad Hilton Hotel, Chicago, Ill.

QUEBEC SECTION, CANADIAN ASSOCIATION OF TEXTILE COLORISTS AND CHEMISTS

Mar 17 (McGill Univ, Montreal, Que); Apr 20-21 (Annual Meeting, Sheraton Mt Royal Hotel, Montreal); June 16 (Annual golf tournament).

SOUTHERN TEXTILE EXPOSITION

19th Exposition, Oct 1-5, Textile Hall, Greenville, S C.

SYNTHETIC ORGANIC CHEMICAL MANUFACTURERS ASSOCIATION OF THE UNITED STATES

Mar 13, Apr 12 (Palm Terrace Suite, Hotel Roosevelt, New York, N Y); May 16-18 (Outing—Skytop, Pennsylvania); June 12, Sept 11, Oct 9, Nov 7 (Palm Terrace Suite, Hotel Roosevelt, New York, N Y)

TEXTILE RESEARCH INSTITUTE

1956 Annual Meeting—March 22-23 Hotel Commodore, New York, N Y.

TEXTILE TECHNICAL FEDERATION OF CANADA

5th Bi-annual Textile Seminar—June 5-7, Queen's Univ, Kingston, Ont.

OBITUARY

LOUIS DISERENS

THE recent death of Louis Diserens in France at the age of 64 brought to a close a most distinguished career.

Having obtained his degree at the University of Zurich, Dr Diserens had a successful period in Russia as a textile colorist until the end of the first World War, when he joined the printing firm of Scheuer, Lauth & Co, in Thann, France, where he rose to the position of general manager.

An outstanding chemist-colorist, Dr Diserens contributed numerous articles to the French periodicals. His first volume, "A Review of the Advances of Dyeing and Printing Methods", appeared in French. Later he published a series of thoroughly comprehensive works on the chemical technology of the textile fibers, which included 3 volumes of "The Technique of Dyeing and Printing", and a similar number on "The Chemical and Functional Finishing of Textiles".

He leaves a widow, who is the sister of the famous Marcel Bader, inventor of the Indigosols.

TECHNICAL LITERATURE

(It is understood that the following literature is available from the sources listed in italics).

BIOGRAPHICAL ABSTRACTS ON EVALUATION OF BRIGHTENING AGENTS FOR DETERGENT USAGE, STP NO. 177——*$1.50; American Society for Testing Materials, 1916 Race St, Philadelphia 3, Pa*——Brightening agents are essentially colorless dyes which, when applied on textiless, absorb ultraviolet irradation and emit light of a bluish hue complementary to the yellow tint already present on the off-white substrate. In this manner the brightening agents impart a greater whiteness to the materials treated. Although brighteners were originally applied to paper, they were incorporated in detergent compositions about 1945. The growth of this application has expanded to the point where brightening agents are available for most types of fiber and detergent compositions. The literature has grown so that a bibliography of the published methods was desirable. This bibliography has been prepared by Lloyd E Weeks, Monsanto Chemical Co, a member of Subcommittee T-5 on Physical Testing of ASTM Committee D-12 on Soaps and Other Detergents.

Thirty-seven titles and abstracts are included. References are numbered consecutively and are listed by year and then by author or by journal if the article is anonymous.—*9 pp, 6 x 9, heavy paper cover.*

CHEMICALS FOR THE TEXTILE INDUSTRY——*Rohm & Haas Co, Philadelphia 5, Pa*——Revised booklet T25b dated January, 1956, lists chemicals Rohm & Haas supplies to the textile industry, including reducing and stripping agents, desizing materials, resin finishes, synthetic sizes, dispersing agents, and surfactants.

ESTERS BY GLYCO——*Glyco Products Co, Inc, Empire State Bldg, New York 1, N Y*——The fatty acid esters of glycerol, glycols and polyethylene glycols are described in this 24-page catalog, which includes tables of the physical and chemical properties of these nonionic surface-active agents.

FABRICS FOR EASIER LIVING——*Rohm & Haas Co, Washington Square, Philadelphia 5, Pa*——This folder is a reprint of an article which appeared in the September-October 1955 issue of the *Rohm & Haas Reporter*, with a cover designed around the 1955 Maid of Cotton. The article is devoted to modern wash-and-wear cottons, which are produced by a resin finishing process.

NEWER USES FOR CHEMICALS FOR THE TEXTILE INDUSTRY——*F-8679B, Carbide and Carbon Chemicals Co, 30 East 42 St, New York 17, N. Y.*——This 26-page booklet features Niatex antistatic AG-2, a new finish for textiles. It also reviews a wide variety of products useful as wetting and retarding agents for dyeing, as dispersing and pasting agents, and as solvent components of dyebaths.

In addition there is a discussion of Carbide raw materials for use in textile fiber synthesis and modification; and in the production of resin finishes.

The newer uses of surface-active agents and water-soluble lubricants in textile processing are also examined.

SURVEY OF CACHALOT BRAND FATTY ALCOHOLS——*M Michel and Co, Inc, 90 Broad St, New York 4, N Y*——This 12-page booklet describes a large line of straight-chain aliphatic alcohols. It includes over 100 uses for Cachalot C12 to C18 higher alcohols as intermediates and additives, showing typical reactions, infra-red spectra, solubility charts, etc.

TEXTILES: ACCELERATED WEATHERING VERSUS OUTDOOR EXPOSURE TESTS — **PB111761**——*$1.25; OTS, U S Dept of Commerce, Washington 25, D C*——Comparative effects of outdoor exposure and accelerated aging on cotton, rayon, nylon and other synthetics, plastic materials, and coated fabrics are described in a 49-page report recently released to industry by the Office of Technical Services, U S Department of Commerce.

The research described in this report was done by the U S Air Force Air Material Command to determine the reliability of an accelerated weathering unit (Type X1A, no water spray) for testing fabrics, as compared with ourdoor exposure tests.

In the outdoor tests, samples of 40 different fabrics were exposed to the sun at an elevated test site in New Mexico for periods from one to nine months. Samples of the same fabrics were subjected to accelerated aging in the weathering unit for periods ranging from 20 to 100 hours. Breaking strength and tearing strength properties were used as the basis of comparison of the two methods of aging.

Findings of both types of tests were generally in agreement. Certain fabrics, however, gave results after outdoor exposure which were not predicted by accelerated aging. It is suggested that, since weathering unit results are not always conclusive, the unit should be used chiefly as a screening device.

Testing methods are described and results charted in this report.

TEXTILES & TESTING COURSE OF STUDY— 2nd EDITION——*$2.75; United States Testing Co, 1415 Park Ave, Hoboken, N J*——This 96-page spiral-bound book is presented in outline form and is well illustrated with sketches, photographs and sample test reports. In addition, there are 16 swatches covering the basic weaves. The major chapter headings are: Introduction to Testing; Raw Materials of the Textile Industry; Yarn Manufacturing and Testing; Fabric Manufacturing and Analysis; Hosiery Testing; and Chemical Tests on Fabrics and Dyestuff Analysis. The Raw Materials section has been enlarged to include up-to-date fiber and yarn information. The new Wool Grade Standards and Recommended Standard Textile Regains have been included. The Flammability unit has been revised in accordwith the Federal Flammable Fabrics Act.

THE ISCC-NBS METHOD OF DESIGNATING COLORS AND A DICTIONARY OF COLOR NAMES——*$2.00 ($2.50 foreign); Supt of Documents, U S Government Printing Office, Washington 25, D C.*——The National Bureau of Standards has compiled this comprehensive dictionary with the cooperation of the Inter-Society Color Council (ISCC). It has been published as NBS Circular 553. by Kenneth & Kelly and Deane B Judd. The end result of four years of research and study, this dictionary not only includes color names from the various fields of application but also relates all the names listed to a common. fundamental system of designation. It lists 7500 individual color names and defines them in simple, accurate terms. Included are such prosaic color names as *red, pea green,* and *dull reddish yellow* along with more fanciful names such as *kitten's ear, vamp,* and *French nude.*

Listings are arranged in such a way as to permit anyone to translate rapidly and accurately from one color vocabulary to another. For example, the dictionary shows that *griseoviridis* (from biology) is equivalent to *serpentine* (fashion), to *mint green* (mass market), and tinally to *light green* (ISCC-NBS color designation).

Earlier dictionaries of color names, which define each color by an actual color swatch, have had limited usefulness in industry because many fail to show the extent of the color range indicated by the name. In the Bureau's color dictionary this effect has been overcome by the use of a method of designating colors through combinations of 21 generic terms—red, yellow, green, light, dark, and so on. In this system all possible colors are divided into 267 groups, each identified by combinations—such as *dark red* or *light green*—of the 21 generic terms. These denifitions are said to provide an easily understood, concise, systematic color language composed of simple unambiguous hue names and modifiers.

The terms used to designate colors represent a refinement of a method outlined originally by the Inter-Society Color Council and developed by the National Bureau of Standards in 1939. These color designations are precisely defined in terms of the standards of the Munsell color system, and the designation for any color may be read quickly and conveniently from color-name charts. It is now possible to determine the ISCC-NBS color designation for a sample whose color is specified in terms of another system of colored samples if the Munsell notations of the reference samples are known.

Circular 553 is made up of four parts. The first part describes the techniques for determining the ISCC-NBS color designations for the colors of different types of samples. Next come the color-name charts from which the designations are obtained. The third part lists all of the color names studied in groups that are synonymous or nearly so; there are 267 groups, one for each of the ISCC-NBS color designations. The last part, which might be called the dictionary proper, is an alphabetical list of all of these color names, together with their designations in the ISCC-NBS system. With each color name is given a code letter indicative of the field in which it is used. After each ISCC-NBS designation defining a color name is a number referring to the section in the third part where all synonymous color names will be found.

All double color names, such as *turquoise blue,* and synonyms within one system are cross-referenced. For instance, under "blue" are five paaes of cross-referenced blues, from "blue, abstract" to "blue, zephyr." Altogether, there are about 17,000 entries, with more than 600 entries under blue alone.

The dictionary of color names should prove useful to anyone looking for a name to describe a certain color. If one wishes to find color names for use in a particular field, such as dyes, he has only to look for the key letter denoting that field among the entries in the dictionary. On the other hand, if he has already chosen a color name, he can use the same code letters to determine in what field it has been used before. The manner in which the dictionary is compiled makes evident differences in meanings of the same color name in different fields. Industrial designers and executives who wish to coin new color names should also find this dictionary useful not only as a source of suggestions but also to make sure that the new name does not already have an establishing meaning.

NAMES IN THE NEWS

Birdsall

Charlton

Firpo

Reynolds

E W BIRDSALL has been named New England manager of Geigy Dyestuffs, Division of Geigy Chemical Corp, replacing W F TURNER, who resigned January 1. The branch is located in Newton Upper Falls, Mass.

For the past five years, Mr Birdsall has been in the Company's main office in New York where he was in charge of sales of Mitin durable mothproofer. New head of the Mitin Department will be W F CHARLTON, who was heretofore Mitin promotional director in Canada.

Mr Birdsall joined Geigy in 1928 and served in the Boston laboratory and sales office in various technical and sales capacities until he came to New York in 1950. He is a member of the Drysalters Club of New England and the AATCC. In the latter organization he is chairman of the research committee on resistance of textiles to insect pests.

JACK H FIRPO has resigned from his position as sales manager of Woonsocket Color & Chemical Co, Woonsocket, R I, to accept another assignment.

Mr Firpo joined Woonsocket's export department in New York in February, 1942. He was transferred to the main office in Woonsocket, R I in September, 1943. After 3 years in the military service, he resumed his position in December, 1947, and was named sales manager in 1948.

The Chas S Tanner Co, Providence, R I, recently announced the appointment of E HAYS REYNOLDS to their Southern textile sales staff. Since 1947 he has been employed with the Keever Starch Company serving as assistant manager of the Southern Textile Sales Division. Working from Tanner's southern office in Greenville, S C, he will serve the North Carolina, Virginia and Tennessee areas.

MILTON HARRIS has been appointed director of research of The Gillette Company, in addition to his duties as president and active head of Harris Research Laboratories. He has acted as a research consultant to The Gillette Company for the past ten years, and was initially retained because of his knowledge of keratin chemistry. In his new assignment he will direct and coordinate the research activities of the various divisions and subsidiaries of the company including Gillette Safety Razor Co, Gillette Industries, Ltd, London, The Toni Co and the recently acquired Paper Mate Co.

INTERCHEMICAL SCHOLARS AT LOWELL TECH——— Four $250 scholarships have been awarded to students at Lowell Technological Institute by the Interchemical Corporation, Pawtucket, R I. Shown at the presentation ceremony, left, to right, are HAVEN A MORRISON, technical representative in Interchemical's Textile Colors Division; FRANCIS L McKONE of Dracut, Mass, '56; MARCELLA S CSEKANSKI of Dracut, '56; MATTHEW J QUIGLEY, New England district manager of Interchemical; GEORGE A CHERRY of Lowell, Mass, '57; PHILIP S LAMPREY of Chelmsford, Mass, '56; and LTI dean of students RICHARD W IVERS.

احتصاص

— ARABIC FOR

SPECIALIZATION

IN ANY LANGUAGE,

PEERLESS MEANS SPECIALIZATION

PEERLESS COLOR COMPANY, INC.

521-535 North Avenue, Plainfield, New Jersey

Manufacturers of Dye Colors since 1916.

Export Representative:, Herbert Lorenz, Inc., World Traders

299 Madison Avenue, New York 17, N. Y.

Cables: HACOLORENZ

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FRANCIS
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12, 1956